TROPICAL DISEASES BUREAU.

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APPLIED HYGIENE IN THE TROPICS.

By Colonel W. G. King, C.I.E., I.M.S. (Retired).

REPORTS.

Korea, 1915–16.

The Governor General of Chosen (Korea) has issued his Annual Report for 1915–16, from which it is evident that rulings have been put in force which should bring the area in his charge well to the front as an instance of sanitary progress in the East. At a recent Census, the population of Chosen was found to amount to 16,278,449; of which 15,957,630 were Koreans, 303,659 Japanese and 17,160 foreigners.

Notification is demanded for cholera, typhoid, typhus, bacillary and amoebic dysentery, smallpox, scarlet fever and paratyphoid. "In control of these diseases, the police have authority to enforce partial or complete quarantine of houses, neighbourhood or city as the conditions demand. . . . Geisha girls, public prostitutes, waitresses or inmates of questionable restaurants are retained under definite police survey."

The total deaths for the year are not stated, but from an analysis afforded of cases and deaths from notifiable diseases in which there had occurred failure to report, it is ascertained that cholera, diphtheria, typhus, typhoid, smallpox, and dysentery prevailed during 1915–16. If failure to report be in some sense a gauge of frequency, it would appear that typhoid and paratyphoid divide with dysentery precedence in death causation. Accepting the same uncertain test, the Japanese were much more severely affected with typhoid and paratyphoid than the Koreans, in proportion to the respective populations.

Sanitary Associations to the number of 986 exist in rural areas, to which are assigned Municipal functions. They are supported by local taxation.

Ten cities are now supplied with public water works and two more systems are under construction. Slaughter-houses are under police supervision and unsuitable meat is rejected. [In his reference to this subject, the Governor General states that the "Koreans are heavier meat eaters than the Japanese."]

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Veterinary conditions are under special rulings—embracing control of epizootics.

Considerable expenditure is entailed in affording medical care of the population by means of a Government General Hospital at Seoul and 18 Provincial Charity Hospitals. Itinerating physicians are also provided. For leprosy a leper hospital exists in Shoroku Island.*

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* From a summary by Dr. R. G. Mills.

DISEASE PREVENTION.

Malaria.

Drainage and Agriculture as Anti-Malarial Measures.

Bengal.—In a Sanitation Number of this *Bulletin* [Vol. 7, No. 7, June 30, 1916, p. 405] it was pointed out that agriculture is the ally of sanitation in that drainage ensures that aeration of soil which is essential to healthy plant growth, and at the same time secures that absence of surplus moisture which is favourable to mosquito breeding. Further experiments by the Agricultural Department of the Government of India, as reported in the "Quarterly Agricultural Journal," again suggest very definitely the direction in which by co-operation the sanitarian and agr culturist may best protect both the economic and sanitary interests of populations from the malign influence of malaria. *Indian Engineering* (Calcutta) of Sept. 29, 1917 [p. 170], in an article dealing in detail with the researches made by the Indian Agricultural Department, affords the following extract from the published Report* :—

"All the facts so far obtained fit into the aeration theory and we have come to regard the surface layer of the alluvium [Indo-Gangetic] as a vast oxygen filter separating the atmosphere from the subsoil water which, analysis shows, is particularly poor in dissolved oxygen. All soil-aerating agencies, like surface and subsoil drainage, at once increase production provided the supply of organic matter in the soil is adequate."

After many years of hesitation as to what particular method should be adopted for combating malaria in Bengal, it would appear from the following telegram by Reuter (if the word "drainage" is to be accepted in its usual interpretation) that the Local Government of that Presidency is about to embark upon an anti-malarial measure of no mean order, in which drainage assumes its correct place as the great co-ordinating factor of agriculture and sanitation :—

"*Fighting Malaria in Bengal.*"

"Calcutta. Jan 29 (delayed). In announcing to-day new drainage projects of several hundred square miles in the fever-stricken districts of Bengal, Lord Ronaldshay, Governor of Bengal, said that the grim tragedy of malaria was causing annually 350,000 deaths and 200,000,000 days of sickness in this Presidency alone.

"The present schemes, he added, were mainly anti-malarial, but they were also expected to increase the crops. One of these schemes had already been completed, and was now yielding an annual profit of more than a hundredfold."—Reuter.

British Guiana.—In a paper read before the Society of Tropical Medicine and Hygiene in November 1917, Dr. A. T. Ozzard, Government Medical Officer, British Guiana, discussed as one of the "Sanitation Problems of the Sugar Estates and Villages of British Guiana," this question of the relation of agriculture to malaria.† He stated that Malcolm Watson "maintains that in a flat country such as British Guiana malaria should be effectually extinguished by

* Agricultural Research Institute, Pusa.

† *Trans. Soc. Trop. Med. & Hyg.* 1917. Vol. 11. No. 2.

cultivation alone." With this opinion he does not concur and supported his attitude by stating :—

"I know of no single estate in the Colony on which it can be said that malaria is non-existent, not even for all practical purposes. . . . Speaking generally, the estates which are along the coast line have a much less malaria incidence than those which border on the banks of the big rivers. And yet . . . every one of them—coast or river estates—adopts precisely the same methods of cultivation and drainage. Why there should be such a difference, so far as malaria and health conditions generally are concerned, between the estates along the coasts and those along the river banks is one of the problems to be tackled."

He thus describes the method of drainage pursued [p. 72] :—

"This [drainage] so far as British Guiana is concerned, is a very important matter. The sugar estates, and indeed the only inhabited parts of the colony, are either situated along the coast-line or, for a very few miles, along the banks of the three big rivers of the colony. All this portion of the land, and for many miles inland, is perfectly flat, so that there is no natural drainage of any kind. The sugar-cane plant cannot thrive unless the land in which it is grown is exceedingly well drained. To attain this object a system of sluices and so-called 'kokers' are depended upon, these being placed near the outlets of the main wide draining canals, into which open all the navigation trenches and smaller cross-drains. By the opening and shutting of these sluices and kokers according to the state of the tide, the excess water is drained off and the salt sea-water prevented from entering.

"So with the adjoining villages—their smaller drains all eventually lead into the big draining trenches.

"But with regard to smaller or larger collections of water, the land being perfectly flat, great difficulty is encountered in dealing with any such."

[Dr. OZZARD in differing from Dr. Malcolm WATSON offers no statistics, and deals with generalities leaving the problem open. Dr. Malcolm WATSON'S statement is also a generalization, and he doubtless would be the first to admit that exceptional conditions in an area may be expected to bring about exceptional results. But Dr. OZZARD gives such good reasons for the breeding of Anophelines in the neighbourhood of dwellings that it might well have been offered as a solution of the problem of localized malaria, without minimizing Malcolm WATSON'S dictum. Evidently, drainage of land sufficing for sound agricultural results would, as to malaria amongst inhabitants, have but little influence in epidemiology in the presence of pools in the immediate neighbourhood of dwellings, as thus described by him :—"Although there are highly cultivated areas of land amongst which the labourers and estate staff live, yet the immediate surroundings of the dwellings of all such may be eminently suitable for the breeding of malaria carrying mosquitoes."

When land in the neighbourhood of villages can be efficiently drained for successful agriculture, it can but be the result of a *laissez faire* policy by owners or public authorities that efficient drainage is not applied to immediate surroundings of dwellings, in the interest of anti-malaria measures. The condition is analogous to a community possessing a public sewerage system and neglecting to effect its junction with dwellings.

The circumstances described by Dr. OZZARD point to a fact greatly neglected by those who have opposed drainage as an anti-malarial measure, on the ground that the drainage of huge areas would involve enormous expense for the safety of a few thousands of the many

million inhabitants of a country possibly possessed of scanty funds: namely that, whilst some form of drain conveying the collected water to a distant discharge point may be requisite, the actual area drained in detail need not exceed a zone round villages, whose radius is greater than the normal flight distance of the Anophelines of the neighbourhood.

The contrast made by Dr. OZZARD between the malarious condition of estates along the coast land and those which border the banks of big rivers (those in the latter area being the greater sufferers) is the real problem suggested by his paper. This must be solved by local expert knowledge; but, in the meantime, the writer suggests that it is significant of the advantage of agriculture and drainage as anti-malaria measures that, according to Dr. OZZARD, "sugar cane cannot thrive unless the land in which it is grown is exceedingly well drained," and that a preference for the opening of the estates near the coast line is evident. Within this selected area, there may exist, in the tidal control arrangements of drainage described by Dr. OZZARD, a system by which aeration of the soil—of advantage to agriculture—is facilitated by the check and flow influence upon the subsoil water securing a respiratory movement of air, whilst the removal of surface and subsoil water, in the aggregate, may be more complete, although intermittent, with resulting proportionately greater benefit against malaria. In any case, British Guiana accomplishes its drainage, in spite of difficult topography, by the open method which when carefully supervised is of advantage, but does not afford the ideal offered by subsoil drainage; whilst to secure the value of tidal influence the distal ramifications of drains, such as are likely to be found in the neighbourhood of dwellings, would require special attention.]

The Control of Irrigation.

In India the work of A. H. HOWARD, C.I.E., at the Pusa Institute, and of W. H. HARRISON, B.Sc., in Madras, has shown that for sound agriculture aeration of the soil is essential and, therefore, water-logging and water waste are inimical. The engineers in charge of the Irrigation Branch of the Indian Government Department of Public Works, since the days of Baird SMITH, have not failed to show that a canal whose efficiency is reckoned in cusecs at the head works may well belie a financial estimate based thereon or its possibilities, owing (irrespective of evaporation) to seepage from the canal bed to the adjacent soil. DEMPSTER, of spleen index fame, and Baird SMITH recognized that irrigation canals which by seepage, wasteful water measurement and distribution, or bad alignment, brought about water-logging, were factors of vast importance in malaria propagation, and consequent sickness and mortality of the populations which irrigation canals were intended to benefit. Ross has, in the meantime, shown the reason why.

Thus it is seen that to-day agriculture, engineering and sanitation agree that, *for reasons held by the respective sciences to be of vital importance, not a drop more water than can usefully be employed for plant growth should pass from canals to soils served by them.* If to this consensus of opinions it were possible to urge that, putting aside the difference in value of healthy and unhealthy populations, it would be, financially, a sound undertaking to sink capital in preventing waste and seepage, for which a handsome financial return might be expected,

it might well be hoped that irrigation in tropical countries will prove a blessing devoid of the alloy which has hitherto been so apparent.

The *Indian and Eastern Engineer* (Calcutta), in its issue for September, 1917, p. 78, takes note of papers read at the Punjab Engineering Congress by Mr. F. W. Woods, Chief Engineer—"The Absorption Losses of Punjab Irrigation Canals"—and by Mr. T. A. Curry, Executive Engineer—"Lining Irrigation Channels."

The total wastage in canals was reckoned as follows:—

(*a*) Loss in the Main Canal and Branches..	20	per cent.
(*b*) Loss in Distributaries	5	,, ,,
(*c*) Loss in Watercourses	20	,, ,,
(*d*) Loss arising from Waste on the fields ..	25	,, ,,
	70	per cent.

The papers show that, in the 8 million acres under irrigation in the Punjab, if absorption losses could be eliminated, 1⅔ million additional acres could be served. This addition would yield on "the present average net revenue of Rs 3 per acre, an annual net return of Rs.5,000,000, while the value of the crops irrigated would be increased by nearly six crores of rupees per annum." This, it is held, implies that whilst about 8,000 cusecs are lost by absorption "a capital outlay of Rs.12,500 would be well spent for each extra cusec" delivered for irrigation: so that "on the average for the whole of the Major Canals of the Punjab an expenditure of Rs.10 to Rs.12/8 per hundred square feet of wetted area would be profitably spent on the elimination of percolation losses" [see also this *Bulletin* (Sanitation Number), Vol. 7, No. 7, June 30, 1916, p. 440].

Reclamation of Water-Logged Tracts.

Indian Engineering (Calcutta) of September 15, 1917, p. 150, places on record evidence of the tendency in India to realize that water-logged soil is both in regard to the health and wealth of communities a bad asset, and that of the various methods of remedy at disposal drainage, in its various forms, has merit that has required no experimental test for many generations. It reports that under the Lower Chenab Canal (which is not water-proofed) an area became so water-logged as to give the cultivators reasons for petitioning tor compensation—even rice cultivation affording no satisfaction. As a result, in 1905–06, a drain 31 miles in length was arranged to connect with an existing escape channel, which led to the river. This scheme seems to have taken little or no cognizance of the circumstances under which water-logging was present; "the bed of the drain on an average was only 1 ft. below the natural surface." Success did not follow this work. In 1914, however, "the reclamation of the swamped area was again mooted, and this time a proposal to dig a drain of 7 ft. wide and an average depth of 5 ft. below natural surface was carried out." Evidently at this depth and breadth relief of the overtaxed soil was feasible. As a result, "7,000 acres of land previously a swamp have been made available for cultivation." Seven tributary drains have been added, and "*aeration and natural fertilization of the soil seem to*

be better in the immediate neighbourhood of the drains [italics not in original] when luxuriant rain grown crops were visible during the *rabi* of 1916–17."

"*Lives and Dollars Saved.*"*

America is not letting it be imagined that, having conquered malaria in Panama in the interests of international commerce, the experience gained in the fight would not be used for the defeat of this enemy of labour in her more immediate midst. Edwin GOULD (Chairman of St. Louis South Western Ry. Co., U.S.A.) as a result of "recent study of health conditions on the railroad, and the large employees' hospital," formed the opinion that loss of health and of labour value under the influence of malaria was of vast importance. This impelled him, from his private funds, to form "a trust fund amounting to many thousand dollars" for anti-malaria measures. Charles SAVILLE, Director of Sanitation, City of Dallas, and H. W. VAN HOVENBERY, Sanitary Engineer, St. Louis, South-Western Ry., have written an interesting account of the result so far secured, in the *Engineering News Record* (New York) of January 24th, 1918. In this, after recounting the origin of the campaign, they point to the public importance of anti-malaria efforts now being made by the U.S.A. Army authorities in connection with the encampments for the vast bodies of men assembled for military training in the United States. The practical demonstrations of benefit in the encampments by the Army authorities have afforded object lessons to "communities adjoining encampment sites which they are utilizing in getting rid of malaria." [A good illustration of the fact well known to all practical sanitarians that, whilst education of peoples is an aid to "peaceful penetration" of sanitation, it is by *practical demonstration of its benefits* that sure and quick progress can be secured—"cleanliness begets cleanliness, dirt begets dirt."]

The city of Dallas, which was the object of anti-malaria efforts, contains 140,000 inhabitants. In the Mexican quarter of the city, 30 per cent. of the inhabitants were found on microscopical examination of blood to harbour tertian parasites.

"In an area of 17 square miles, there were some 40 miles of water courses favourable to the development of mosquitoes." For the draining of these, the topography of the area was favourable. It was determined to give first attention to parts of creeks and streams recognizable as active anopheles breeding places, and then proceed to deal with the less important places elsewhere.

"The work consisted in both places in :—

"(a) Clearing of banks of grass, weeds and débris, to destroy shelters and facilitate ditching and oiling.

"(b) Ditching of streams to get channels of minimum cross-section, with sufficient flow to keep the channel scoured.

"(c) Filling large holes situated under bridges and at ends of culverts, pot-holes in creeks, overflow pools, etc.

"This work was followed by oiling water surfaces at regular intervals or, where feasible, by stocking with, or cultivating the growth of, top feeding minnows in streams and ponds.

"The field work embraced six main streams having a total length of 30 miles and an average high water channel width, before the work started,

* This "to the point" phrase is used as a sub-head by the authors of the article under reference.

of approximately 30 ft. Extensive marshy areas were also drained by ditches, several thousand feet in length, *reclaiming many acres of valuable land for agricultural and business purposes.* [Italics not in original.] The field force comprised five to ten men during the summer months. They were paid 25 c. an hour in 1916, and 30 c. in 1917. . . . The field equipment included short and long handled shovels, hoes, trench spades, picks, rakes, grass-cutting tools, axes, storage of oil barrels, 5-gal. oil cans, two Meyers Bros. No. 330 G.I. knapsack sprayers, and a Ford runabout equipped with a delivery wagon body.

"Algae growth and moss were removed from the creeks by sweeping with a stable broom. Attractive sign posts giving police warning were erected to discourage throwing of trash in streams and to prevent mischievous boys from building dams. A municipal ordinance was adopted to compel the removal of mosquito-breeding areas on private property. Along with actual field work, an educational campaign was carried on through public lectures, health department publications and exhibits. . . .

"About 300 gal. of a compounded oil were used monthly. The oilers waded down the creeks with knapsack sprayers on their backs, replenishing their supply of oil at regular filling stations. The cost of field work on the six principal streams, including all supplies, wages, automobile expenses, and supervision, during the active mosquito season, averaged about $16 per month per mile. . . .

"An indication of the reduced prevalence of malaria in Dallas is shown by the records of the City Charity Hospital. Only four patients were treated for this disease in July and August, 1917, as compared with 85 such patients in the same months in 1916. . . .

"The records of the Dallas city registrar show that there were 27 deaths in Dallas during the year ending Aug. 1, 1916, which was before anti-malaria work was well started. During the following 12 months there were only nine deaths from malaria, a reduction in mortality of 66⅔%, despite a material increase in population. Assuming the value of a life to be $3,000 and the cost of an average case of malaria, for medicine, attendants, and wages lost, to be $25, and using the ratio of one death to every 400 cases, we find a probable economic saving to Dallas inhabitants through reduction in the disease to have been nearly $200,000, or about $1·25 per capita. Compare this saving with the 3c. found to be the actual cost per inhabitant of effectively controlling malaria. What other investment yields so great a return?"

South Africa.

Dr. W. R. Greening, in the *South African Medical Record*, April 14, 1917, gives an account of a successfully conducted campaign against malaria which is remarkable for the numerous factors involved, and the rapidity and thoroughness with which these were got rid of. The environment concerned was that of a permanent camp containing 500 whites and 2,500 natives. In this camp "every year saw an outbreak of more or less severity, according to the rainfall, culminating in the season 1914 and 1915 when malaria was very rife, in some cases whole families being down at one time and a large percentage of the Mine staff constantly sick." The following were some of the more obvious conditions that demanded attention in undertaking anti-malarial measures:—

Mosquito breeding facilities.—The camp is surrounded by thick bush, interspersed with baobab trees, and bounded on the east by a range of huge kopjes, from the direction of which comes the prevailing wind; these kopjes consist of huge masses of rock in which are large numbers of hollows, which hold water after rain: one and a half miles to the south is a series of shallow water holes forming a large breeding area of mosquitoes on the path of the prevailing wind, and abutting on the township a rocky flat holding pools during the rainy season: waste

water from baths received directly on ground and garden irrigated: uncovered tanks, cisterns, etc. Certain trees were a special "source of danger in that they harbour water for long periods after rain." For example, the Maroola tree, which has "an innocent looking little hole at about four or six feet from the ground of one to two inches in diameter . . . this hole leads to a cavity in the trunk capable of holding anything up to five or six gallons of water, according to the age and size of the tree. This water remains sufficiently long "for several successive lots of larvae to hatch out." Paw-paw trees were also found to afford water-holding hollows.

Mosquito carriers.—Cattle, especially those with dark hair, and police in dark uniform were found to be involuntary bearers of Anopheles. In reference to the cattle as carriers, the distant water-holes used by them were brought under control.

Malaria bearers.—Squatters resided in the neighbourhood of the camp as well as uncontrolled natives.

The chief anti-malaria measures pursued were: "all houses were screened," the squatters were brought into camp, a native location was formed. All drains and hollows were filled "regardless of expense"; hollows of trees were stuffed with clay or the trees were cut down; hollows in rocks were filled with concrete, but where "at a great height and the most inaccessible places imaginable" they were kept under control by the use of paraffin.

Results.—The campaign was started in 1915. Writing in April 1917 Dr. GREENING states that "the campaign has been completely successful in its object, and during the last season and the one now almost concluded, there has not been a single case of fever incurred locally."

[This campaign affords a good instance of the successful employment of what are classed as "minor anti-malaria measures" uncomplicated —so far as stated in Dr. GREENING's paper—by quinine prophylaxis.]

Anti-Malarial Measures in Madras.

It required popular pressure, following a considerable exacerbation of malarial fevers amongst the population of the City of Madras in 1913, to induce the Municipal Corporation to regard anti-malaria measures "seriously." After the decision to adopt an anti-malaria policy, action however has been continuous and persistent. The population is already reaping the benefit of these efforts; in 1916, malaria caused 4·3 per cent. of the total mortality, against 9 per cent. in 1913, and 11 per cent. in 1914.

The practical experience acquired in Madras City in the use of various anti-malaria measures has therefore a distinct value. An interesting record by Dr. K. RAGHAVENDRA RAO is found in the Annual Report for 1916 of the "Health Department and Special Malaria Department of the City of Madras."* Instead of adopting the views of the enthusiast for this or that special anti-malaria measure, he espouses the common-sense opinion that each recognized method has its sphere of utility. He classes reclamation and drainage as *radical measures of permanent utility*, and cleansing of ponds, petrolising, clearing and quininisation as palliative measures of temporary utility

* Printed by Thompson & Co., 33, Popham's Broadway, Madras.

requiring intermittent and insistent care, but necessary of adoption until radical measures have secured their influence. In illustration, he states that large marshy areas have been drained; "the drainage work has been supplemented by reclamation, and it may be fairly claimed that in these directions tangible and striking success has been achieved."

In connection with the maintenance of "tanks"* in conditions inimical to mosquito breeding, Dr. RAGHAVENDRA RAO invites attention to a legal ruling suggested by his predecessor (as special anti-malaria Officer), Capt. HODGSON, I.M.S. This suggested ruling it seems to the writer is equitable, and is likely to commend itself to those concerned with anti-malaria measures generally. Capt. HODGSON'S recommendation is as follows† :—

"It will be necessary that some permanent fund be put aside yearly to keep these tanks clean. And I propose suggesting that it should be necessary for the owner of a tank to have a license to keep the tank, otherwise he must be compelled to fill it up, and the fee for this license should be sufficient to pay for the cleaning of the tank periodically at the expense of the Corporation. It is perfectly impossible to expect private owners to keep their tanks clean. They have neither implements nor the trained staff to keep them clean even if they were cleaned in the first instance by the Corporation. Also it will be far more expensive for the private owners to keep a gang to clean them than that the Corporation should undertake the work for them. If it is insisted that private owners are to keep their tanks clean, it will mean a large staff for inspecting these tanks and a very large number of cases in court every year. That is to say the maximum amount of discomfort and the minimum amount of efficiency."

On the subject of employment of fish as larvicidal agents, Dr. RAGHAVENDRA RAO gives the following as the result of extensive experiments, and observation of results in practice‡ :—

"After further experience with these fish I doubt whether they are as useful under natural environments as under somewhat artificial conditions. Fish are not of much use as enemies of mosquito life if the water surface is covered with plenty of weeds, leaves and twigs; for then, they cannot get access to the little mosquito larvae which find a safe shelter underneath the floating material of this description. . . . It therefore comes to this, that, fish or no fish, mosquito larvae thrive in a tank or pond which is not kept cleaned and recleaned; and if it is kept so cleaned and recleaned, mosquito larvae do not thrive, fish or no fish. This does not mean that fish do not, to some extent at least, act as larvicidal agents in the intervals between the cleanings."

Quinine Prophylaxis.

The Sanitary Commissioner for the Government of Bombay, in his Annual Report for 1916 [p. 14], states, "Three thousand six hundred and sixteen pounds of quinine were sold or distributed free in the Presidency and Sind by district local boards, municipalities, and post offices." He holds that "malaria is practically present throughout

* The word "tank" as used in India refers to collections of water used for domestic purposes or for cattle and clothes washing; at times, unfortunately, for all three purposes combined! Their area is frequently considerable. Thus, the Report under notice mentions tanks of 600′ × 54′, 120′ × 660′, 200′ × 100′ and so forth.

† Corporation of Madras. Annual Report of the I. Health Department and II. Special Malaria Department of the City of Madras for the Year 1916. 1917. Madras: Thompson & Co. pp. 122–123

‡ *Loc. cit.* p. 123.

Sind" ; in that area, 685 lb. or the equivalent to 1·5 gr. per head of population was distributed, but to use quinine reasonably as a prophylactic "50 to 100-fold the weight" is really necessary. He, therefore, advises that as provision of quinine to this extent would obviously be impossible, the prophylactic use of quinine should be confined as far as possible to school children, "with a view to getting the maximum benefit from the limited available supply."

The juvenile Department of the Bengal Jails does "its bit" in the prevention of malaria, by manufacturing tablets of the quinine received from the Government Cinchona Plantation in the Darjeeling Hills. The outturn of these tablets in 1916 amounted to more than the yield of the plantations, namely, 64,314 lb., against a normal average produce of 50,000 lb. Supplies were made to the Medical Stores Depôt of Madras and Bombay.

Yellow Fever.

? In Maracaibo.

As a result of Dr. Scott's work in Jamaica "vomiting sickness" will no longer be regarded as a mild form of yellow fever. Maracaibo, in Venezuela, is another locality where a fever locally known as yellow fever awaits a determination of its character by expert investigation. According to the Annual Report of the Surgeon General of the Public Health Service of the United States for 1917, p. 126, the "general trend of medical opinion, both of physicians there and leading men in Caracas, both medical and others, seems to be that occasional cases of yellow fever occur there and in that vicinity." On the other hand, "the Yellow Fever Commission of the Rockefeller Institute is inclined not to believe in the endemicity of yellow fever in Maracaibo." Nevertheless, as deaths were hardly ever reported from this disease, German firms before the war "made it a practice to send young employees just out from Germany first to Maracaibo, in order to contract the mild form for which the place was noted. Sometimes one died, but it was exceptional."

Breeding Places for Mosquitoes.

Dr. Allan, Medical Officer of Health, Freetown, in his Notes embodied in the Annual Medical Report, Sierra Leone, for 1916, states [p. 65] that he found 13·8 per cent. of 67 wells examined contained mosquito larvae. The larvae, as diagnosed by the Imperial Bureau of Entomology, were :—"*Culex decens* in 54 wells ; *Stegomyia fasciata* in 8 wells ; *Culex insignis* in 2 wells ; Anopheles in 1 well ; *Culiciomyia nebulosa* in 1 well ; *Culex tigripes* in 1 well."

In 506 instances, mosquito larvae were found in cavities of trees, most commonly *Stegomyia fasciata* and *S. simpsoni*. Out of twenty specimens of larvae from cavities, fifteen "bred out" were of the former variety. During the year, 609 cavities were treated with cement.

Dysentery.

Poona.—According to the Sanitary Commissioner for the Government of Bombay 1916 (Lt.-Col. Hutchinson, I.M.S.) the mean death rate from diarrhoea and dysentery for the quinquennium, in Poona, amounted to 8·97, and for 1916, 4·85.

This mortality has been assigned on the one hand in the main to the agency of flies and, on the other, to contaminated water-supply. At one period, chlorination of the public supply seemed to have settled the matter; but inefficient carrying out of this method is now held to have vitiated the possibility of arriving at a definite conclusion [see this *Bulletin* (Sanitation Number), Vol. 10, No. 1, July 15, 1917, p. 21]. In the meantime, it is evident that in the Bombay Presidency there are other nurseries of diarrhoea and dysentery which may reward sanitary effort, the mean quinquennium death rate from these diseases in Sholapur being 12·27 and 9·22, respectively. In regard to Poona, the Sanitary Commissioner states* :—

"The slightly enhanced mortality from these diseases [dysentery and diarrhoea] during the year was associated with the increased incidence of cholera. The invariable prevalence of these diseases in the monsoon months is connected with the washing into water supplies of surface impurities. The partial sterilization of the Poona city water-supply was carried out throughout the year. The death-rate was below that for 1915 and very nearly half the quinquennial mean. The system of distribution is very faulty and to some extent vitiates the result of the initial partial sterilization. If a good system of distribution and more perfect sterilization were possible the death-rate in Poona city from these diseases would decline still further. The experience of 1915 held out the hope that the monsoon epidemic in Poona cantonment would not recur. Unfortunately this was not realized, and the opinion was freely expressed that water could have no causal connection with the disease. It must be remembered that the sterilization of the water was very imperfectly done, owing to the dose of the re-agent not being calculated. It was also found that the water issuing from taps differed bacteriologically very considerably from that in the pure water reservoir. The possibility of insuction of an impure subsoil water is being investigated."

Sierra Leone.—The Sierra Leone Annual Medical Report for 1916 contains much evidence of increasing attention to dysentery. The prevalence of this disease in the Freetown Prison is reported by Dr. D. Burrows (Acting Principal Medical Officer) to have led to the introduction in that institution of "apparatus for cooking and sterilizing all food and feeding appliances." In regard to water, the precaution taken is "the boiling all water and the provision of shower baths."† He holds that, under these conditions, the "majority of cases are introduced from without." These methods are strengthened by a "thorough examination of new-comers" by Dr. Young, resulting in cases of acute dysentery being detected "as well as their equally dangerous companions the cyst carriers." These cases are promptly isolated, "until it is reasonably supposed they are free from infection."

The Report of the Medical Officer (Dr. W. A. Young) in charge of the Prison shows that 161 cases of dysentery were treated during the year.

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* Fifty-Third Annual Report of the Sanitary Commissioner for the Government of Bombay, 1916. 1917. Bombay: Printed at the Government Central Press. p. 13.

† Open troughs surrounded by drained platforms, from which prisoners paraded for bathing removed water *by dipping* were, some years back, common in Indian Jails, although at the present time largely superseded by shower bath systems. In two instances of cholera epidemics investigated by the writer, contamination by choleraic matter of such troughs was proved. Equally in the presence of all water-borne diseases, open troughs must be dangerous. In spite of stringent discipline and provision of safe sources of drinking water, there is risk of these being used for the latter purpose.

In describing means for protecting food and water from contamination, he states that "all cooking baskets, receptacles, boards, etc., can be and are sterilized each day." The cooks also are not excluded from prophylactic efforts, as they are given "injections of emetine at intervals as an additional precaution." Doubtless, in the midst of measures thus carefully instituted, all possible care as to night soil conservancy and laundry arrangements for prisoners is also observed, but unfortunately the Report furnishes no details on these points.

Naturally, in view of his opinion that the prison suffers by reason of importation of the disease, Dr. YOUNG draws attention to the prevalence of dysentery in the free population of Sierra Leone. He holds that the "conditions are such that amoebic carriers are plentiful in Freetown and the habits of the people tend most effectively to spread of the disease." To the employment of the Freetown inhabitants in the campaign in the Cameroons, he ascribes the spread of dysentery in the force employed there. Dr. YOUNG concludes his Note on the subject as follows [pp. 30–31]:—

"Although amoebic dysentery may and can be spread by water contamination, the water supply of Freetown, as it arrives at the standpipes and taps, at the present moment, does not contain *Entamoeba histolytica* or its cysts. Since so far no case has been shown by bacteriological methods to be due to Shiga and Flexner's Bacilli, it may safely be assumed that the dysentery here is spread more or less directly from person to person."

But Dr. YOUNG adds a saving clause of no small import:—"Water supply does not include the Freetown wells."

When the Report of the Medical Officer of Health of Freetown (Dr. W. ALLAN) is consulted on the question of the nature of "the wells" of Freetown, it is found that cesspits or cesspools (of which there are 3,000) are in close proximity to them. Dr. ALLAN thus sums up the position:—

"So long as cesspools are allowed to exist, it is out of the question to expect any marked reduction in the amount of intestinal disease, which is becoming one of the most acute problems the Sanitary Branch has to deal with. The elimination of all well water as a domestic supply might improve matters, but the cesspits would still continue to contaminate the soil, to breed flies and so spread infection.

"The solution lies in the closing of all cesspits, and all wells, and the general adoption throughout the city of the dry earth pan closet or the introduction of a water-carriage system" [p. 76].

Dr. ALLAN is hopeful of at least an improved water supply being at disposal by completion of the Freetown water-works, which will include increase in the size of the Tower Hill reservoir "so as to bring the total service capacity up to one million gallons." He adds that "well water is still drunk by the inhabitants."

[The facts referred to by the Medical Officers concerned show that the extensive precautions rightly adopted in Freetown Prison can only be regarded as defensive, and that constant importation of the disease must be expected. Not only must Freetown therefore be regarded as still the subject of incomplete sanitary measures against malaria and a possible nidus of yellow fever, but as a centre whence areas in communication with it incur danger of spread of intestinal infection.

The soundness of Dr. ALLAN's advice as to closure of all wells, even in the presence of a complete public water-supply, is obvious. The

average Oriental is not alone in forgetting that the nearest source of water-supply is not necessarily the purest. Radical improvements will presumably be regarded as a necessity "after the war."]

Jamaica.—In his Report, as Government Pathologist, embodied in that of the Superintending Medical Officer, Jamaica, for 1916-17, Dr. H. H. Scott recalls the fact that, a short time back, it was held that amoebic dysentery [p. 43] did not exist in Jamaica. On examining 191 specimens for this form of the disease, he however found that 89 conformed to the type. These results he urges "must be earnestly regarded as a note of warning." They show that the disease "is a menace now and likely to become much more serious when the troops return from the front, for a large number of the dysentery cases from the Eastern theatre of the War at least are amoebic."

Helminthic Influence and Dysentery.

Dr. Young, in the Annual Medical Report for Sierra Leone, 1916 [p. 31], finds a relation between infestation by worms of the intest nes and dysentery, as follows:—

"The presence of the ova of various intestinal worms is almost an invariable quantity in the examination of faeces otherwise regarded as normal. Now, during the stage of acute or sub-acute dysentery these ova were rarely noted, but as soon as a convalescent patient's faeces reached the stage of containing 'a few pus cells and a little mucus and no erythrocytes and amoebae' the ova began to re-appear, the presumption being that the morbid condition of the intestinal tract was inimical to the egg-laying function of the parasite."

[According to Mauté (Military Medical Manuals—edited by Col. A. Balfour, A.M.S., and Capt. George C. Low, I.M.S.) "Dysentery, Asiatic Cholera, etc." [p. 41], great practical importance should be attached "to the investigation of associated parasites, the superaddition of these seeming to maintain and augment the resistance of the amoebae."]

Yaws.

Of thirty-three districts and localities reporting on the subject of yaws, according to the Annual (1916–17) Report of the Superintending Medical Officer, Jamaica, only three state that this disease is not prevalent. Such terms as, "exists in overwhelming numbers," "exists in every part of the district," "very prevalent," etc., used by the Medical Officers concerned, show that the suppression of this disease is a matter of importance to the Jamaica population.

Considerable effort is being made by the Medical Officers to induce affected persons to submit to treatment. At p. 7 of the Report, a list is given showing the drugs employed in 2,557 cases, and the average time for cure of symptoms. These were kharsivan, salvarsan, arsenobenzol Billon, and galyl. Unfortunately, the groups of cases are not always differentiated in respect to the actual drugs used (certain of which are presumably chemically the same, although supplied with different names), but as, in several instances, only one of these drugs was employed, some idea of efficiency can be formed. At p. 26 of the Report, however, remarks as to the comparative efficacy of four preparations employed in treatment of 424 cases is afforded by Dr. C. A. Moseley, District Medical Officer, Port Antonio, as follows:—

"As regards the relative merits of the different preparations, I found that Diarsenol gave excellent results. It is more soluble than any of the

others named above, and pain and swelling at the seat of injection very rapidly disappeared. The cases treated with it were all very severe cases of general yaws; in children it was marvellous the rapidity with which the symptoms disappeared.

"Galyl was sent to me in only emulsion for intramuscular injections and was used almost exclusively in the treatment of children, the results obtained were good.

"Kharsivan I thought more toxic than the others, several cases of jaundice developed and several of the persons treated had gastric intestinal symptoms.

"Arsenobenzol was used more extensively than any of the others, not because it was thought to be a better preparation but because it was the one supplied most frequently. The results were uniformly good and no toxic symptoms occurred, in any of the persons treated."

[Having regard to the apparently inoculable nature of this disease (by transfer by flies or other mode of contact of discharges with abraded surfaces) there would seem room for inauguration of systems of house and personal hygiene in prophylaxis—including occlusion of abraded surfaces—as an adjunct to the present adoption of curative measures.]

Smallpox.

Protection by Vaccination.

Dr. K. Raghavendra Rao, Health Officer of the City of Madras, in his Annual Report for 1916, furnishes the following table and appended remarks. In interpreting the results generally and especially the percentage of infants under one year attacked, it must be held in mind that vaccination is not compulsory in the City area under six months of age* :—

"The following remarks are based on 673 cases of smallpox, in which the vaccinal conditions of every case were accurately reported after a careful and personal observation. Of the 673 cases the reports of 485 cases were received from the two Corporation Infectious Diseases Hospitals recording the vaccinal conditions of cases of small-pox admitted in them :—

	Vaccinated.		Unvaccinated.	
	Attacks.	Deaths.	Attacks.	Deaths.
Under one year	12	5	63	39
Above one and under five years ..	32	9	69	34
Five and under ten years ..	53	2	17	5
Ten and under fifteen years ..	45	2	8	2
Fifteen and under twenty years ..	76	4	11	1
Twenty and under twenty-five years	71	3	8	1
Twenty-five years and above ..	181	15	27	13
Total ..	470	40	203	95

"Of the 75 cases amongst infants under one year of age whose vaccinal conditions were verified it is found only 16 per cent. of the attacks with a case mortality of 41·7 per cent. were amongst the vaccinated, against 84

*Corporation of Madras. Annual Report of the I. Health Department and II. Special Malaria Department of the City of Madras for the Year 1916. 1917. Madras: Thompson & Co. p. 28.

per cent. and 62 per cent. respectively in the unvaccinated. The same relative advantage to the vaccinated as against the unvaccinated is again illustrated in the next age group 1 and 5 in which the ratios work out as follows :—

	Per cent. of attacks.	Case mortality.
Vaccinated	31·68 ..	26
Unvaccinated	68·32 ..	50 "

The Health Officer points to the importance of re-vaccination, and whilst recognizing the difficulty of securing the sanctioning of this ruling urges that " at least it may be made compulsory for contacts to get themselves vaccinated." Under his encouragement and the incitement of epidemic smallpox, this prophylactic measure is receiving increased attention ; there being recorded 46,120 re-vaccinations in 1916 against 4,622 in 1914.

In his Annual Report for 1916, the Sanitary Commissioner (Lt.-Col. F. H. G. Hutchinson, I.M.S.) for the Government of Bombay gives the following results of a similar investigation* :—

" One thousand four hundred and eighty-two attacks of smallpox were investigated during the year by officers of the Sanitary Department. Of these, 954 were among the vaccinated, and 528 among the unvaccinated. Of the former, 40 died, giving a case mortality of 4·2 per cent. Of the latter, 123 died, causing a case mortality of 23·3 per cent., over 5 times as great as among the vaccinated.

" The average age of vaccinated persons attacked by smallpox was 18 against 8 for unvaccinated persons. The average age of the vaccinated persons fatally attacked was 22 against 4 for unvaccinated persons. These are very important figures and indicate the protection against smallpox afforded in early life by vaccination.

" Among the vaccinated less than 1 per cent. of the fatal cases were in infants under one year, while among the unvaccinated the percentage was over 10. It is necessary to explain the fatal incidence of the disease among vaccinated infants. An enquiry proved that the smallpox eruption broke out on the 4th or 5th day after vaccination. The immunity afforded by vaccination may take 14 to 21 days to develop, so these infants were unfortunately not vaccinated in time."

Rocky Mountain Spotted Fever.

In dealing with " Rocky Mountain spotted fever " the U.S.A. Public Health Service has encouraged the employment of sheep grazing, because " sheep in small bands naturally graze in a manner adapted to tick [*Dermacentor occidentalis*] eradication." For this purpose, during 1917, 45,000 sheep were introduced into the Bitter Root Valley after the following experiment had been made† :—

" The introduction of these sheep was a result of several seasons' effort, and if sheep grazing upon this scale can be placed on a business basis in the valley, so that the movement will be continued from year to year, it is expected that it will go far toward clearing up the spotted-fever situation.

" A band of 500 sheep was secured for experimental use and grazed first in a near-by tick-free irrigated pasture, then for 10 days over adjacent tick-infested territory, and finally back to the pasture for observation. The purpose of this experiment was to show that by watching the tick

* Fifty-Third Annual Report of the Sanitary Commissioner for the Government of Bombay, 1916. 1917. Bombay.: Government Central Press. p. 20.

† Annual Report of the Surgeon General of the Public Health Service of the United States for the Fiscal Year 1917. 1917. Washington : Govt. Printing Office. pp. 225–226.

infestation closely on a small band, the sheep might be grazed over territory showing a high degree of infestation, provided they are shifted as often as every 10 days to nearly tick-free pasture. . . .

"The entire spotted fever situation, so far as the Bitter Root Valley is concerned, appears to be much more satisfactory than ever before. The adoption of proper grazing methods, the realization of the inadequacy of dipping domestic animals, the continuation of small animal destruction, and the contemplated enactment of suitable legislation, have all served to place the work of tick eradication and the elimination of spotted fever on a more scientific basis. There is reason to believe that if these procedures can be continued as outlined the ultimate control of spotted fever infection in this district will be effected."

Beriberi.

Notwithstanding the overwhelming evidence of the position of beriberi as a vitamine deficiency disease, it remains to be proved that under this term, in the tropics, one or more diseases, of which the symptomatology is similar, do not owe their origin to other causes. There are therefore still advocates of an insect-borne beriberi. Dr. Arthur Stanley, Health Officer, Shanghai, in his Annual Report for 1916 [p. 26] makes the following observations on the subject :—

"Four new cases of Beri-beri occurred. Since 1899 the number of cases of Beri-beri among prisoners in the Gaol in sequence of years was 27, 34, 134, 0, 0, 2, 2, 2, 1, 5, 78, 16, 7, 0, 2, 13, 0 and 6 during the year under review. From 1899 to 1901 the ordinary sanitary measures of isolation and disinfection were carefully carried out without success, no special measures against infestation with body vermin being taken. The new Gaol, presumably vermin free, was then occupied and at first no cases of Beri-beri occurred, in marked contrast to the severe infection in the old Gaol. From 1904 till 1909 the cases of Beri-beri gradually increased, reaching a maximum in 1909 when the Gaol was found infested throughout with bugs. During the last four years measures were taken to exterminate bugs which are held responsible for the reduction in the number of cases of Beri-beri. The diet during the whole of this period was substantially the same."

The Acting Health Officer, Rangoon (Dr. J. Hormasji), in his Annual Report for 1916 [p. 6] states that 122 deaths from beriberi were registered during the year ; of these 105 were reported from hospitals and other public institutions. The deaths from this disease for the different races were proportionately as follows :—

Race.	*No. of deaths.*	*Rate.*
Hindus	71 ..	·65
Mahomedans and Malays ..	19 ..	·35
Burmese	17	·20
Chinese and Panthays	3	
Others	12 ..	·52

Having regard to peculiarities of diet of these races living in the same locality, such statistics if maintained from year to year should be of value.

Ankylostomiasis.

India.

Attention was directed to the presence of ankylostomiasis in the Madras Presidency by Asst. Surgeon Haddon, I.S.M.D., in 1886, by Surgeon Captain Williams, I.M.S., in 1895 (*Indian Medical Gazette*, May, 1895, p. 195) and Captain Fearnside, I.M.S., in 1896. Their observations however resulted chiefly in increased care being given to

the influence of infestation upon prisoners. A Reprint of a paper which appeared in the *Indian Journal of Medical Research* (Vol. 4, No. 4, April, 1917) on the subject of the conditions as found in the Madras general population has been largely officially circulated in India. This contains the record of an investigation by Dr. K. S. MHASKAR, with a covering note forwarding it to the Advisory Board of the Indian Research Association.

Dr. MHASKAR selected, as an appropriate centre of observation, the Recruiting Depôt at Negapatam, whence coolies are drafted to the Straits Settlements. As there is no restriction as to area of recruiting, the coolies assembled there are fairly representative of the labouring population of the various districts of the whole Presidency. As a corrective to deductions drawn solely from the labouring class, haphazard examination of citizens of all classes of the town of Negapatam was also undertaken.

Samples of stools for examination, Dr. MHASKAR found, were best collected "in drachm vials containing 1 or 2 per cent. lysol." This he prefers to the use of 70 per cent. alcohol, as "it not only sterilizes all material but acts as a deodorant and shows up the ova quite as well as alcohol." He found that ankylostomiasis infection occurs "in all classes of people irrespective of locality, caste, sex, age or occupation." The total found infected amounted to 98 per cent. in 10,000 examinations. With one exception, the genus Necator was universally recognized.

In Major Norman WHITE'S Note [p. 14] the following occurs :—

"From reports already received we were aware that the percentage of the coolies infected was extraordinarily high. By personal examination of all specimens that are returned as 'negative' by his staff, Dr. Mhaskar now finds that the percentage infected is even higher than his early figures indicated. The percentage now approximates 99, in fact it is a permissible generalization to assert that *all* the coolies passing through the depôt are infested with hookworms in varying degrees. The extreme importance and significance of this observation will be discussed later."

Of other intestinal parasites, the following were the percentages observed in 7,577 cases :—

Species of parasite.	Total number of cases from.			Percentages in.		
	Depot.	Town.	Villages.	Depot.	Town.	Villages.
1 Ankylostomes . .	5,797	1,326	237	98·5	91·4	98·7
2 Ascaris lumbricoides .	3,483	1,025	114	59·2	70·4	45·8
3 Trichuris trichiura .	2,191	653	89	37·2	44·8	37·0
4 Strong. intestinalis .	439	122	17	7·4	8·3	7·1
5 Oxyuris vermicularis .	89	40	3	1·5	2·7	1·2
6 Taenia solium . .	30	11	—	0·5	0·7	—
7 Taenia saginata . .	24	13	—	0·4	0·2	—
8 No infection. . .	26	29	2	0·4	2·0	0·8
9 Coprophagia. . .	4,789	1,256	182	81·4	86·3	75·8
Total number of cases examined . . .	5,882	1,455	240	=7,577		

In regard to health conditions in sufferers from ankylostomiasis, Dr. MHASKAR states :—

" The physical condition of coolies, who are more or less selected, in the depot, demonstrates that hookworm infection is not incompatible with apparent good health. On the other hand, the examination of the school children in Negapatam town and two villages indicated that hookworms are responsible for deterioration of physique, anaemia, and much ill health."

[This confirms the accepted opinion that all ankylostome bearers need not necessarily exhibit ill health. The contrast however indicated in regard to children is worth pursuing further, by research as to the influence of the second most common infestation shown in the above table, namely, with *Ascaris lumbricoides.* Whatever may be said in favour of the opinion held by some that in its presence a toxic influence is forthcoming, there can be no doubt of the disturbance of the nervous system and of physiological functions generally caused by it, and in this respect, children would obviously be peculiarly susceptible. Practical experience in curative treatment amongst Indian children shows that this simple fact cannot be safely ignored. Indeed, both in adults and children, in diseases attended with hyperpyrexia, removal of ascarides at a critical moment often proves a life-saving measure.]

In discussing the marked prevalence of ankylostomiasis in the Madras Presidency, Dr. MHASKAR states :—

" There is the almost universal custom, among the male inhabitants of small towns and villages, of going outside in the morning to any piece of unoccupied land for the purposes of nature. Women and children use back-yards, or a small enclosure especially laid apart, which is open to wind and rain and often accessible to fowls and pigs so that the excreta are scattered broadcast."

Disinfection of Faeces.

The U.S. Public Health Service Report for 1917 affords information as to the present position in respect to treatment of faeces which, where financially feasible, would be of advantage as an aid in an anti-ankylostomiasis campaign* :—

" From this study it was determined that sodium hydroxide and probably copper sulphate will kill hookworm eggs in feces within reasonable time, at a moderate expense, and with a minimum of labor. It should be observed that *Ascaris* eggs are more resistant than hookworm eggs, and *Endamoeba coli* and *Lamblia* spores less resistant.

" When the disinfected excreta were poured out on the ground, the odor was slight, less than that connected with stable manure. Thus it seems probable that a method may be developed whereby human excreta can be disinfected against the germs of animal parasites as well as against those of typhoid fever and similar diseases, at a low expense, and with little labor, and that the excreta may then be used promiscuously as fertilizer."

VOMITING SICKNESS.

It will be remembered that Dr. H. H. SCOTT, the Government Pathologist, Jamaica, as a result of careful enquiry and experiment has been able to show that the fear, largely entertained, that the " vomiting

* Annual Report of the Surgeon General of the Public Health Service of the United States for the Fiscal Year 1917. 1917. Washington : Government Printing Office. p. 68.

sickness" of Jamaica was in reality a mild form of yellow fever was baseless. In an investigation into the causation of an epidemic in Duncans District, Trelawny Parish, he was confronted with evidence which, under a less careful method of enquiry, might have led to the belief that "ackee" poisoning had nothing to do with the matter. Cross-examination of the sufferers however elicited full support to Dr. SCOTT's dictum. He ends his Note on the subject by stating, "I am inclined to ascribe the severity of the outbreak to the fact that, owing to the recent hurricane, bananas are very scarce, and the presence of the affection in this district year after year may be due to the scarcity of breadfruit in this locality."*

PLAGUE.

Rangoon.

In Rangoon, plague has been present since 1905. The figures furnished in the Report, for 1916, of the Acting Health Officer (Dr. HORMASJI) for that city show that in each year from 1912 to 1916, inclusive, in no month was plague absent. In 1916, the deaths from this disease amounted to 1,810. During the year 385,161 rats were destroyed.

Guayaquil.

The necessity for radical changes in Guayaquil had attracted considerable attention before the outbreak of the war. As a consequence of present conditions the water-supply, which was one of the sanitary works contemplated, has been interrupted in progress. Pending this city being "sanitated," it should form an excellent locality for the ardent student of tropical medical science. If it be desired to study yellow fever (216 cases), plague (577 cases), smallpox, typhoid fever, malaria, intestinal parasites, dysentery (bacillary and amoebic), tuberculosis, chickenpox, and poliomyelitis, according to Passed Asst. Surgeon Herman B. PARKER† all were present during the past year. There is usually no lack of material as to yellow fever Although it certainly would not do, in the absence of special investigation, to quote Guayaquil as affording definite epidemiological data on any subject, the statement made by Asst. Surgeon Parker as to plague that "no cases were imported" in the higher altitudes although "they occurred in the country surrounding Guayaquil" is noteworthy in contrast with a recent expansion of the rat flea theory (Ninth Report of the Indian Plague Investigation Commission).

Fumigation of Ships.

S. B. GRUBBS, Surgeon U.S.A. Public Health Service, has carried out experiments with fans for getting rid of sulphur dioxide or hydrocyanic gas employed for fumigation of holds of ships as a part of

* Jamaica. Annual Report of the Superintending Medical Officer, for the Year ended 31st March, 1917. 1917. Jamaica: Government Printing Office. p. 43.

† Annual Report of the Surgeon General of the Public Health Service of the United States for the Fiscal Year 1917. 1917. Washington: Govt. Printing Office. p. 114.

anti-plague measures, with the object of diminishing the time of refraining from loading. He states (*Public Health Reports*, 1917, Oct. 19, p. 1759) :—

"Electric blowers possess little power and the wires are troublesome to handle, consequently they have been abandoned in favor of a gasoline driven air propeller designed to propel boats and sleds. This is a two-cylinder, two-cycle, air-cooled, 3-horse-power gasoline engine, driving a two-blade propeller, 32 inches in diameter, at about 1,600 revolutions per minute. According to measurements made at this station it delivers about 22,700 cubic feet of air per minute. This fan has been tried within the holds, where it served the double purpose of circulating the gas and increasing its penetration. . . . It will be seen that this machine will in 10 minutes deliver into the bottom of the hold an amount of air equal to the aerial content of the average ship's hold, but it has been found that gas is rarely expelled in this short time sufficiently to make the hold safe for persons entering.

"The original vertical machine has at our suggestion been changed so that it will operate in a horizontal position, thus driving the air directly downward. Mounted on a wooden frame the horizontal machine weighs less than 100 pounds and may be easily hoisted aboard a vessel. When operated it is placed across the corner of an open hatchway and may be carried from one place to another without stopping the motor. Furthermore, it may be used with or without a shute. In holds of less than 30 feet depth it is probably as efficient without as with a shute, but as this latter can be easily attached by means of four snap hooks it may be advisable to use it when the hatchways are small and the holds deep. Anemometer readings at the bottom of an 18-foot shute gave approximately 8,500 cubic feet per minute and practically the same reading was obtained when the anemometer was held the same distance beneath the machine without the shute."

Typhoid.

Chronic Carriers.

Public Health Reports for Oct. 19, 1917, p. 1755, in an account of a milk-borne typhoid epidemic (by C. F. Bolduan and C. Krumwiede, Jr., Department of Health, City of New York) affords an instance of difficulty in identifying a "carrier," should there be failure at the time of examination to excrete typhoid bacilli. They state :—

"We were in error, therefore, because the carrier first found was a normal carrier, a fact unsuspected at the time. The presence of such a carrier raises interesting possibilities. Had we relied wholly upon the Widal reaction for the selection of fecal specimens and had S.M. given positive fecal results at the time, we would have excluded him and agreed to the resumption of the milk supply. Should L.M. have continued to excrete bacilli, the excretion by normal carrier being not necessarily as transient as it was in his case, we should have left an unsuspected carrier, who might have been the source of infection for subsequent cases.

"Although a positive Widal reaction may be absent in chronic carriers, the results indicate that even if a farm helper is found to be excreting typhoid bacilli, any other individual giving a partial or positive Widal reaction should be held under suspicion. At least, fecal examinations should be made over a period of time, as excretion even with chronic carriers is intermittent and negative examinations are not infrequent, and may extend over months or even for a year."

Food Preparation and Typhoid.

The Government Pathologist, Jamaica (Dr. H. H. Scott), in his Report to the Superintending Medical Officer for 1917 (Annual Report of the Superintending Medical Officer, Jamaica, 1917) affords remarks showing that the use of Widal's reaction "is a wise precaution" in

safeguarding the preparation of food. "Examinations as to bakers and others in analogous employments being possible carriers of disease are made prior to the men being employed for such purposes and, as a preliminary, the blood is sent up to be tested for agglutinin formation." 1,302 sera were forwarded for examination: of these 37·40 per cent. were positive, 56·30 negative and 10·25 per cent. doubtful. He adds that sera from 71 apparently healthy subjects at the Penitentiary gave 18 positive results.

Leprosy.

In the Report of the Health Officer (Dr. J. E. Thomson), Brisbane, embodied in the Annual Report of the Commissioner of Public Health, Queensland, to 30th June, 1917, the total patients stated to be under treatment for leprosy was 43, as follows:—White males, 14; white females, 2; coloured males, 25; coloured females, 2.

The male coloured inmates were South Sea Islanders, 12; Chinese, 1; Japanese, 1; aborigines, 8; half-caste, 4; Kanaka, 1. The character of leprosy found is defined as "nodular leprosy" and "mixed leprosy."

No other treatment but that with chaulmoogra oil was pursued. He justifies adherence to this method on the ground that [p. 12] "many cases have benefited by its use, and any new substance will have to prove its merit before it can hope to displace the remedy in the treatment of the disease with a reputation extending over so many years and the high percentage of improvements." He adds that this method was first adopted by Blane of New Orleans in 1888. [At page 530, Vol. 6, No. 9, Dec. 15, 1915 (Sanitation Number), of this *Bulletin* reference is made to the use of gurjun oil. This was introduced in Madras in 1876 by Surgeon Major Dougall, I.M.S., to whom would seem to belong precedence in treatment of leprosy by this class of oils.]

Pneumonia.

Jamaica.—Dr. Lawson Gifford, in his Report embodied in that of the Superintending Medical Officer, Jamaica, p. 23, gives reason for regarding the health conditions of the Kingston Medical District as unsatisfactory. In 1915–16 the death rate per mille was 25·36, in 1916–17, 34·12; whilst in March of 1917 "the death registration reached the enormous figure of 61·50 per 1,000." After remarking on the increase of malaria, typhoid and bowel complaints as contributing to the increased mortality, he furnishes the following remarks as to pneumonia, "which from 69 notifications with 61 deaths in 1915–16 increased to 307 cases with 114 deaths." In reference to these figures he states [p. 24]:—

"What is the explanation? The Medical Officer of Health for Kingston in his report to the Mayor and Council for January suggests the 'possibility of a virulent strain of Pneumococcus* having been introduced from Halifax by home coming convalescents of the Third Jamaica Contingent.' Personally I am not prepared to go so far afield to look for the cause of the trouble. I think the two main, if not sole factors, are to be found in meteorological conditions and poverty, both combining to lower the vitality and restrict the resistive powers of the community. This idea is borne out by the increased incidence of the disease during the last (March)

* On this subject, see *British Medical Journal.* 1918. Jan. 12. p. 57.

quarter of the year concurrently with the violent diurnal changes of temperature (cold nights following hot days) that obtained during those months. The role played by poverty involving insufficient food if not actual starvation, and scanty clothing is obvious. Be the cause what it may there can be no doubt that the prevalence of Pneumonia in the city is a serious matter."

Dr. GIFFORD regards the increased poverty of the population as "a distinct reflection of the war."

Bengal Jails.—In his Report for 1916 the Inspector General of Prisons, Bengal Presidency, makes [p. 20] the following reference to increased incidence of pneumonia :—" The slight increase in the ratio of admissions from pneumonia is well explained by the considerable overcrowding, as pneumonia is above all diseases one of overcrowding."

FOOD.

Fixed Diets.

At page 271, Vol. 6, No. 5, Sept. 15, 1915 (Sanitation Number), of this *Bulletin*, on the adjustment of proteids to carbonaceous items of diet in the Bengal dietary as advised by MCCAY, the Inspector General of Prisons, Bengal (Lt.-Col. W. J. BUCHANAN, C.I.E.), is quoted as stating that whilst he agrees with the arguments of that worker, he held that to secure the result desired (that is, a change of diet that would be received with favour) it was necessary to render the new scale voluntary, until its benefits were fully appreciated. In his Administration Report on the Jails of the Bengal Presidency for 1916 [pp. 18–19] he makes the following remarks on progress secured :—

"A large number of the present-day Superintendents are conservative in their views and seem to think that the rice diet was ordained by Providence for Eastern Bengalis, but on the whole substantial progress has been made.

"As regards actual results, taking the whole jail population of this Presidency, we find that of the prisoners on wheat diet 56 per cent. gained in weight as compared with 53 on Bengal rice diet. As regards sickness we find that while only 45 per cent. of all admissions to hospital came from those on wheat diet, there were 63 per cent. from those on rice diet; and as regards the incidence of *bowel-complaints* we find (as I have preached and predicted) that of the wheat-dieted prisoners only 12 per cent. suffered from bowel-complaints (dysentery and diarrhoea) as against no less than 22·7 per cent. of those of Bengal rice diet.

"I still think therefore that no compulsion should be used and no violent change in the dietary. The superiority of the wheat-scale diet is becoming known and appreciated, but there still exists an older school of Medical Officer and Medical Subordinate who cling to the view that rice is the natural diet of the inhabitants of Eastern Bengal."

[The Jail population forms but a small portion of the total of the Bengal Presidency. It is however largely derived from the poorer and working classes, where the custom of regarding rice as the essential article of diet has long proved inimical. It would therefore seem possible that, in due course, as increments of men converted under Col. BUCHANAN's policy as to their opinions on dietary are restored to the free population, MCCAY's advice may be more widely accepted by the people to their physical advantage. In the Madras Presidency, where although rice is largely grown for commercial purposes and wheat is rare, the staple cereals chiefly used by the poorer classes are millets, the labourer, as a matter of experience, regards rice as a luxury, but

recognizes that if work is to be faced the millet affords better staving powers—as indeed their better proportions of proteids to hydro-carbons would imply.]

Water.

Water Supply and Health.

The Madras City was credited in 1872 with having a public water supply. The catchment area was not preserved by legislation and was year by year subject to increasing risks of contamination, whilst this was still more obvious as to the open channel conveying the water from the impounding reservoir to the point of distribution, absence of filters, etc. Its insufficiency led a considerable section of the people to the employment of sanitarily undesirable wells as an additional source of supply. Under such circumstances, it is not surprising it has been a difficult task for the Corporation to prove the sanitary advantage of water works.

Although under a new scheme the advantage of completed works and distribution cannot yet be claimed, the President of the Corporation, in his Report for 1916–17 is able to furnish the following figures* :—

"In the last Administration Report attention was drawn to the remarkable fall in the death-rate which followed the introduction of the new water-supply in December 1914. It is satisfactory to record that during the year under review there has been a further decline, and the improvement in health has been sufficiently noticeable to call for remarks from employers of labour. The actual figures are so striking that they are worth recording ; they are as follows :—

Year.	No. of deaths in the year.	Death-rate per 1,000.	Remarks.
1914 . . .	24,174	46·6	
1915 . . .	18,683	36·0	First year of new water-supply.
1916 . . .	17,872	34·4	
Average for decade 1901-10 .	22,485	44·0	

"The drop in the number of deaths per year is indeed remarkable After a continuous though irregular rise in the death-rate, it has fallen below the lowest previously recorded.

"Compared with the average for the previous decade there is a reduction of 4,613 deaths per annum. As for each death there are on the average six cases of illness, each lasting seven days, the fall in the death-rate results in the saving of 193,746 days of sickness. From a financial point of view, each day may be taken as worth Re. 1 including loss of wages of the sick person, the medical attendance and time of those who attend on him. Thus the value of the improved health of the city may be taken as Rs.1,93,746 per annum, a large proportion of which may be set down to the credit of the new water supply.

The Sterilization of Water.

An urgent requirement in the tropics to the traveller in mufti or khaki, in peace or in war, is the easy and rapid sterilization of drinking

* Administration Report of the Corporation of Madras for 1916-17. Madras : Thompson & Co. pp. 29–30.

water. No one has given the subject such earnest and constant attention with so favourable results as Major NESFIELD, I.M.S. In recounting progress made on this subject, he recalls the fact not usually remembered that it is due to his initiative, in 1903, that chlorine and hypochlorites have now general acceptance as agents of the first importance. He states :—" The form in which I originally put forward chlorine was the liquid gas in steel cylinders for large quantities and bleaching powder for smaller quantities. The water was dechlorinated with sulphite of soda, and later with hyposulphite."

He insists that all doubts as to utility of chlorine and resulting sterility must disappear before the standing rule that " if free chlorine (nascent oxygen) or iodine can be shown to exist in water by the potassium iodide and starch test the water is sterile." As to quantity of chlorine required, he quotes Major C. R. DURNALL, Medical Corps, U.S.A., in *Journal of the American Public Health Association*, Nov., 1911 :—" In general it may be said that with an average unfiltered river water such as that of the Potomac about 1 in 2,000,000 parts of chlorine are required. For clear lake waters 1 in 3,300,000 parts of chlorine will be sufficient; i.e., it will require 3 to 4 pounds of liquid chlorine for a million gallons of water of average purity." As to length of contact necessary Major DURNALL states that the action is *practically instantaneous.* Major WESTFIELD makes " starch iodide testing fluid by adding 5 grains of starch to 1 ounce of water and boiling till dissolved. When cool add 5 grains of potassium iodide, 5 grains of zinc sulphate and 5 grains of alum. The object of the zinc is to prevent the formation of dextrine. The alum makes the test more sensitive."

He maintains that the employment of chloride of lime for Army purposes and individual use is unsuitable* because it is unstable and its composition unreliable. He condemns its employment in the tropics, and in practice he considers its use in Mesopotamia conduced to inefficiency. For utilization in Municipalities in hot climates, he would advise the formation of solutions of hypochlorites by electrolysis [see this *Bulletin* (Sanitation Number), Vol. 8, No. 5, Oct. 15, 1917, p. 307].

For the private individual or soldier, he considers the only logical chlorine compound is chlorogen. This is sodium hypochlorite combined with 1 per cent. sodium hydrate. Major NESFIELD states that this is now made in India on a large scale, by the following process† :—

" Freshly imported chloride of lime is well macerated with water, and a clear concentrated solution of calcium hypochlorite produced.

" $Ca(OCl)Cl + H_2O = Ca(OCl)_2 + CaCl_2 + H_2O$.

" This fluid is then freed of impurities and particularly chloro-oxy compounds other than NaClO, and titrated till it contains 6 per cent. available chlorine. It is then treated with sodium carbonate till all Ca is precipitated.

" Thus $Ca(OCl)_2 + Na_2CO_3 = 2\ NaClO + CaCO_3$.

" This fluid is again titrated to ensure the presence of 5 per cent. available Cl, and to it is then added NaOH to make a 1 per cent. dilution.

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* See this *Bulletin* (Sanitation Number), Vol. 6, No. 5, Sept. 15, 1915, p. 266.

† *Indian Medical Gazette*, 1917, Oct., Vol. 52, No. 10, pp. 355-356.

"This fluid has remarkable solvent properties, and dissolves cork, wood, leather, etc., but does not dissolve glass, porcelain, or rubber, and hence can be kept in suitable stoppered bottles.

"It has a faint sweet smell suggesting chloroform."

For general and military purposes, he advises 2 drachms of chlorogen to 100 gallons water, allowing for 30 minutes contact. But here he would safeguard the attainment of sterilization, by requiring that the treated water must give a blue with potassium iodide and starch at the end of half an hour.

Interstate Water Supplies.

Nature as well as man is capable of diverting the course of huge watercourses, but the latter is usually content to utilize these as found. In that case, selfish instincts or thoughtlessness of communities in the upper tracts of a river's course frequently influence inimically utilization of water for domestic purposes in the lower tracts. Chiefly, such results are due in already developed countries to lack of that information which sanitary science, especially as aided by its branch of bacteriology, in the present day, is capable of affording. In these countries the rival interests of communities have their outlets in Commissions, Committees, expert "findings," and much legal procedure between official local bodies whose rule of petty areas is conterminous. There is here the excuse of difficulty of breaking the bonds of vested interest.

But, in countries in the tropics now under development, if ordinary foresight be employed, interests should not become so "vested" as to be detrimental to the public health. To effect this, it is well that in the course of development Sanitary Services in the tropics should always guard their position under Central Governments and, whilst not restraining reasonable self-government evolution of Local Bodies should urge that sufficient power of control to secure co-ordination be definitely retained. In certain of our Colonies and in India these principles are in force (largely because Local Bodies derive their origin from Government) but are liable in the course of changing conditions to lapse in favour of excessive devolution.

The Annual Report for 1917 of the U.S.A. Public Health Service gives (p. 235) excellent instances in respect to the protection of water-supplies, of the advantage of Interstate over-rule. The Note opens with recognition of the well acknowledged fact that whilst a periodical bacteriological examination may [by a chapter of coincidences] warn of dangers, the real test of safety is "sanitary surveys at periodical intervals of the watersheds from which supplies are derived." These have now been made obligatory, and certificates in a form showing results of both the sanitary survey and bacteriological analysis are submitted periodically.

This ruling especially aims at protection of passengers passing from State to State, and therefore concerns water-supplies provided on railways and vessels. Of 3,713 waters examined of a total of 4,156, 211 were certified to be "polluted." As a proof of the efficacy of sanitary organisation on the "large map" principle, as against each community being a law unto itself, it must be gratifying to the Massachussetts State Board of Health (which long held the lead in

scientific study of water supplies and sewage disposal) to find that "the low percentage of pollution* in Massachussetts can be attributed to the fact that that State has exercised absolute control over all water supplies for many years, and has amply protected all public watersheds."

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* The total water-supplies concerned was 64; not one was found "polluted."

SANITARY ORGANISATION.

Sanitary Staffs.

If the Sergeant is the "backbone of the British Army," it can safely be said that the Sanitary Inspector is the backbone of any organization dealing with the health of communities. "A turban however does not make a Mohammedan," nor does a duly notified appointment by a Public Body create a Sanitary Inspector. To be of any real utility the man must have acquired a sound general education; in dealing with obstructive members of a community he must possess sufficient discretion to appreciate the advantage of an *arte non vi* policy; and have had an education in sanitary science and sanitary legislation that will enable him to be above mere "rule of thumb" methods. These qualities are requisite in European countries; but in the tropics, he must possess additional virtues. The chances are always that he will be required to deal with large areas for the quick supervision of which riding is requisite, and that to make his requirements understood an acquaintance with more than a single vernacular language is necessary. In localities where the superior engineering staff of the Government or Local Bodies concerned is largely engaged in Major Works in connection with communications, buildings and irrigation, it is essential in rural areas that he should have sufficient knowledge of construction and sanitary engineering to secure that Minor Works should be designed, estimated for and (subject to sanction beyond a specified sum) executed under his care. In the case of India, to these requirements must be added, a sound knowledge of races, caste systems and religions. Here, further, the peculiarity arises of its being desirable that a Sanitary Inspector be of the race, caste* or religion numerically predominant in the locality in which he serves.

The ideal may not always be attained, but it is indubitable that, in the well educated classes of Madras Indians, there is available for service in the tropics excellent material of the character required. Forty years back to have suggested to a Brahmin that he should inspect a slaughter-house where cattle are slaughtered, handle the beef and pronounce as to its quality, or make sure that a latrine used by Pariahs was correctly cleansed, would have been met with indignation. In the present day, both high caste Hindus and Mohammedans willingly qualify as Sanitary Inspectors at their own expense and are capable of exhibiting zeal and keen interest in their profession.

The extent to which the technically qualified Sanitary Inspector is recognized in the Madras Presidency makes, indeed, a sharp contrast to conditions (outside the Metropolis) still existing in the United Kingdom. In his Report for 1916, the Sanitary Commissioner for Madras (Lt.-Col. Justice, I.M.S.) makes the following observations as to the number of qualified Sanitary Inspectors available, and of those in actual public employment† :—

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* Or, in the alternative, be of a caste commanding respect in the locality. In 1909, 65 per cent. of the Sanitary Inspectors, Madras Presidency, were Brahmins.

†Madras. The Fifty-Third Annual Report of the Sanitary Commissioner, 1916. 1917. Madras: Printed by the Superintendent, Government Press. p. 20.

"Two candidates qualified as second-class health officers and fifteen sanitary inspectors in the employ of local bodies underwent the quinquennial course and passed the prescribed examination during the year. From the Assistant Sanitary Inspectors' class in the Medical College ten men qualified; thirty-three assistant sanitary inspectors obtained certificates as qualified sanitary inspectors by passing the examination in Minor Sanitary Engineering under the Sanitary Engineer to Government. Twenty-three men qualified as vaccinators and thirty-nine candidates deputed by Collectors of districts were trained as special plague inspectors for plague duty. Out of a total of 979 qualified sanitary inspectors and assistant sanitary inspectors, 680 are employed in municipalities and district boards on sanitary duty, 86 as deputy inspectors of vaccination and 40 on the provincial cholera reserves."

Sanitary Inspectors.

It is possible that a statement of the method of education and discipline of the Madras Sanitary Inspectors, referred to in the preceding Note, may be of some utility to those about to inaugurate schemes for employment of Sanitary Inspectors elsewhere in the tropics. In regard to education, as the sanitarian would largely adapt this to suit local requirements and the class of men dealt with, it is unnecessary to do more than afford an outline.

In regard to discipline, it will be understood that the rulings were intended for a class of men who are officially recognised by the Local Government and by all Local Bodies, and that no Sanitary Inspector, after 1894, could be entertained by a Local Body or Government Official in any part of the Presidency, unless he possessed a certificate of qualification of the nature prescribed by Government rulings. Yet it was not an embodied Service. That ideal could not be secured on account of financial and self-government legal rulings. Consequently, the rules had to be so framed that when a Local Body entertained a Sanitary Inspector he was their servant, yet was still answerable to the Medical and Sanitary Officers of Districts and to the Sanitary Commissioner as to his professional fitness and conduct. The method excogitated for maintenance of discipline, therefore, is analogous to the registration of medical men in the United Kingdom, with the difference that the Sanitary Commissioner as the registering authority assumes an active, not a passive, interest in conduct, and in securing for a candidate, or preventing, his employment. He also has the power to investigate charges made by Local Bodies, and afford protection when necessary. In aid of these powers, the Certificate of qualification was endorsed to the effect that it was "the property of the Sanitary Commissioner for the time being." Withdrawal of a Certificate and therefore the annulling of the power of a Local Body to entertain the Sanitary Inspector concerned was practised, temporarily, for failure to show at periodical examinations that knowledge had been maintained, or, permanently, for conduct likely to prejudice fitness for the public service. From the latter decision, the Sanitary Inspector held the right to appeal to Government. The Sanitary Inspector is thus rendered reasonably safe from the whims of Local Bodies, as well as from a too autocratic attitude of a Sanitary Commissioner.

The Official Register of Sanitary Inspectors maintained in the office of the Sanitary Commissioner was more than a mere statement for identification and date of qualification of individuals; it was so arranged that the caste and race, age, qualifications by examination

other than sanitary (which are often of a high class), history of service and conduct, good and bad, could at once be traced.

In all countries the Sanitary Inspector requires a "Sanitary Conscience" that is proof against many forms of temptations to debase his sense of duty; in localities where certain classes of Orientals are dealt with, this is especially so. Under the safeguard stated, the experience of the last 23 years shows that the Madras Presidency Sanitary Inspectors, as a class, have proved themselves zealous and trustworthy public servants.

One of the advantages of the method has been that it was possible for the Madras Government Sanitary Commissioner in epidemic periods to entertain temporarily, at Government expense, on less than normal full pay, a Reserve of Sanitary Inspectors who could at a moment's notice be dispatched for duty in threatened or attacked areas under Local Bodies, by whom their pay was met. This method of retaining a certain number of men under control saved much time, which might be lost by Local Bodies in securing unemployed Sanitary Inspectors.

The following extracts from the official pamphlet published [for sale] for public information by the Government Printing Office, Madras, deals with the chief points above alluded to.* The pamphlet contains the full syllabus of education.

"The scheme for the training of Sanitary Inspectors was sanctioned by Government in December 1894, and the first class for Sanitary Inspectors assembled in the Medical College, Madras, in January 1895. The general educational qualification for admission to the class was a pass in the Matriculation or any higher examination, but a certain number of unpassed candidates were also admitted on the nomination of the Sanitary Commissioner. Also unqualified Sanitary Inspectors in the service of local bodies and having less than five years' standing, whatever their educational qualification, were required to qualify within two years or be discharged. The training consisted of theoretical instruction in the Medical College, extending to three months from January to March, and a practical course extending through April. Men who qualified under the above rules are known as Certificated Sanitary Inspectors.†

"2. The examination prescribed for those wishing to qualify as Sanitary Inspectors was the Government Technical Examination in Hygiene (Intermediate Grade) modified by the Director of Public Instruction, in consultation with the Sanitary Commissioner, to suit the special requirements. Subsequently, Elementary Physiology was added as part of the course of instruction; but no compulsory examination was held.

"3. In 1903, the scope of the examination and training was enlarged. Under the new rules the nomination of unpassed candidates ceased, and none but those who have passed the Matriculation Examination of the Madras or any recognized University, the Upper Secondary, or any higher examination, are admitted to the Medical College. Admission is also conditional upon candidates being of good character, certified by the Head of their Schools or Colleges, or their employers.

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* Rules for the Education and Discipline of Sanitary Inspectors, 1912. Madras: Printed by the Superintendent, Government Press.

† To secure up-to-date knowledge, employed Sanitary Inspectors passed annually a written and oral examination conducted by the District Medical and Sanitary Officer of the area concerned. If results were bad the Sanitary Inspector was "warned" by the Sanitary Commissioner, and required to appear again in three months; if then still bad, his certificate was temporarily suspended till improvement was secured. On the other hand, when results were good the Sanitary Inspector was praised accordingly. Local Bodies were requested to supply suitable current Sanitary literature to their Sanitary Inspectors.

"4. The course in the Medical College, Madras, extends from July to December, and consists of theoretical and practical training in General Hygiene, Physiology and Bacteriological Demonstrations under the Professor and Assistant Professor of Hygiene. Outdoor practical teaching is undertaken by these officers assisted (voluntarily) at times by the Health Officer, Madras. . . .

"5. Candidates who qualify under the above rules are known as Assistant Sanitary Inspectors.

"6. The examination prescribed for Assistant Sanitary Inspectors is the Government Technical Examination in the Intermediate Grade in Hygiene and in Physiology, and is conducted by the Commissioner for Government Examinations. The fee for registration is Rs. 4. No candidate will be permitted to appear for it unless he produces a certificate from the Principal, Medical College, of having undergone the five months' theoretical and practical course in the Madras Medical College. The written examinations consist of two papers of three hours each in Hygiene (one of a theoretical, the other of a practical, tendency) and one of three hours' duration in Physiology. There are also oral and practical examinations in the above subjects.

"7. Candidates who are desirous of qualifying for the higher grade of Sanitary Inspector must, in addition to passing the examinations for Assistant Sanitary Inspector as above described, undergo a course in Minor Sanitary Engineering at the Sanitary Engineer's Office, Madras, which extends to five months, viz., from January to May.

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"9. The examination in Minor Sanitary Engineering is conducted by the Commissioner for Government Examinations, but no candidate will be permitted to appear unless he produces a certificate from the Lecturer in Minor Sanitary Engineering of having undergone five months' training in the class specially held for the purpose at the Sanitary Engineer's office. The fee for registration for the examination is Rs. 4.

"10. Candidates who duly pass the examination for Assistant Sanitary Inspectors will be given two certificates—one by the Commissioner for the Government Examinations, in token of having passed the Government Technical Examination (intermediate grade) in Hygiene and Physiology, and another conjointly by the Surgeon-General and the Sanitary Commissioner. *The latter certificate is the token of qualification.* A person not possessed of this certificate and whose name does not appear in the *Quarterly List of Sanitary Inspectors, which is published under the authority of Government, is not entitled to hold an appointment under any public authority in the Madras Presidency. The certificate is granted only to those who have passed the examination after undergoing a course of study in the Medical College, and its grant is conditional on the candidate being of good character and physique. It is the property of the Sanitary Commissioner for the time being, and is liable to be cancelled or suspended by him in case of misbehaviour. Whilst in the employ of a local body, the certificate should be lodged by the Sanitary or Assistant Sanitary Inspector concerned in the office of the District Medical and Sanitary Officer; when not so employed, it is held in the private possession of the Sanitary Inspector. On securing employment, the Sanitary Inspector should not only report himself to the local body paying for his services, but also through that body to the District Medical and Sanitary Officer, sending, at the same time, his certificate. [The certificate of qualification exhibits rulings on these points on the reverse.]

* * * * *

"12. With the view of ensuring that Sanitary Inspectors in the employ of Local Boards and Municipal Councils maintain their efficiency and keep themselves informed of advances in Sanitary Science, these subordinates will be afforded additional teaching in the shape of a course of lectures and

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*"Obtainable from the Superintendent, Government Press, Madras, by any person on payment of As. 12. It is of great importance that each Sanitary Inspector should provide himself with a copy."

demonstrations in the Medical College. This additional course of training and examination will be regulated by the following rules :—

"(1) The examination shall be compulsory at the end of every five years' service of each Sanitary Inspector and every such Sanitary Inspector shall attend the prescribed course and go up for the examination at the end of the course.

"(2) The course will extend over a period of eight weeks and will be held during the summer vacation of the Medical College. The exact date will be notified in the *Fort St. George Gazette*. Assistant Sanitary Inspectors are not eligible for admission.

"(3) The course will consist of two parts :—

"(1) Sanitary Engineering. . . .

"(2) Higher sanitation of a practical nature [instruction being given by the Sanitary Commissioner and the Deputy Sanitary Commissioner.]

"The syllabus in these subjects will be identical with that for the special course for Assistant Surgeons qualifying for the posts of Sanitary Assistants to District Medical and Sanitary Officers.

* * * * *

"(6) To enable Sanitary Inspectors to undergo their training and pass the examination, they should be granted leave for a period of twelve weeks with full pay, and their actual travelling expenses to and fro should be borne by the local body concerned. Sanitary Inspectors who, owing to failure, have to attend the course and appear for the examination a second time will do so at their own expense and on leave without allowances ; and should they again fail, their services will be liable to be dispensed with and their conjoint certificates of qualifications issued by the Surgeon General and the Sanitary Commissioner will be suspended until such time as they prove their fitness by passing the examination.

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"13. The designations of Assistant Sanitary Inspector and Sanitary Inspector are strictly confined to those who have qualified as above and are not applicable to Nuisance Inspectors, Conservancy Overseers, etc.— Sanitary Inspectors should, through the employing bodies, bring to the notice of the Sanitary Commissioner any instance where the term of Sanitary Inspector is used by unqualified persons. *Both the honour and the use of these designations should be jealously guarded by those possessed of them.*

* * * * *

"15. Men qualified as above are eligible for permanent employment as Sanitary Inspectors or Assistant Sanitary Inspectors in Municipalities or in Local Fund areas, and for temporary employment during fairs and festivals, or on the occasion of epidemics ; as rural Observation or Preventive Circle, Disinfection or Divisional, Inspectors on plague duty ; also as Deputy Inspectors of Vaccination, provided they have also undergone training and examination in Vaccination at the King Institute of Preventive Medicine, Guindy, in the following subjects :—

Subjects.	Number of lectures.
(1) Preservation and Bacteriology of Vaccine, and the Science of Asepticism	6
(2) Human and animal vaccination (theoretical). Official routine and law concerning vaccination	12
(3) Common skin and other diseases of man (theoretical) ..	8
(4) Human and animal vaccination (practical)	Daily for 3 months
(5) Common skin and other diseases of man (practical) ..	
(6) Common skin and other diseases of animals (theoretical) ..	8

"16. No local body should newly employ any person as a Sanitary Inspector or as an Assistant Sanitary Inspector who does not hold the following certificates :—

"(i) A certificate of having qualified under the above rulings ; (ii) in the case of an Assistant Sanitary Inspector a certificate from the Sanitary Commissioner that he can cycle ; (iii) in the case of a Sanitary Inspector, a certificate from the Sanitary Commissioner that he can both ride and cycle.

"17. All appointments of Sanitary Inspectors are made by Municipal and Local Fund authorities, subject to the Sanitary Commissioner's approval as to character. This should be formally sought before giving the candidate an appointment. Selections should be made from the Quarterly List of Sanitary Inspectors published every quarter by the Sanitary Commissioner, which is circulated to local bodies. Government also expects that these bodies will seek his advice as to choice of men, in respects to fitness for the particular appointments concerned. The appointment by local bodies of any person whose name does not appear in the Quarterly List of Sanitary Inspectors, or who has not been approved as to character by the Sanitary Commissioner, will be brought to the notice of Government by the Sanitary Commissioner.

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"22. Sanitary Inspectors are entitled to all the advantages as to leave, etc., possessed by other officers in Local Fund or Municipal employ.

"23. To maintain discipline among Sanitary Inspectors, a register is maintained in the Sanitary Commissioner's office in which is recorded everything in favour of or against a Sanitary Inspector as reported by employing officers, and as a result of observation by District Medical and Sanitary Officers, the Deputy Sanitary Commissioner and the Sanitary Commissioner. The Sanitary Commissioner is empowered to remove from the register any Sanitary Inspector who has misbehaved himself, and to cancel or suspend his conjoint certificate according to the gravity of the offence. During the temporary suspension of the certificate, the employment of the Sanitary Inspector under any public authority is prohibited. It is, however, open to any one whose name has been removed from the register to appeal to Government, through the Sanitary Commissioner, against the decision of that officer.

* * * * *

"25. To secure employment, candidates should register their names at the office of Sanitary Commissioner, giving the following information. Any change of address should at once be intimated :—

"(a) Age ; (b) languages known and whether knowledge is colloquial only or extends to reading and writing ; (c) examinations passed ; (d) where employed and length of service in each capacity ; (e) date of appointment in present post ; (f) permanent address ; (g) father's name and profession.

"26. Local authorities will be supplied with information as to candidates on application.

"27. To enable the Sanitary Commissioner to meet the requirements of Government as to the maintenance of a register, all local authorities employing Sanitary Inspectors are requested to intimate to the Sanitary Commissioner any matter in favour of or against their conduct, and the date of first joining and giving over charge of an appointment."

Railway Laboratory Car.

In aid of the Interstate supervision of water-supplies, the U.S.A. Public Health Service is employing a Railway "Sanitary Car" known as the "Wyman," in commemoration of the late Surgeon-General Walter Wyman. This is a remodelled Pullman carriage which was completely equipped as a laboratory, adequately provided with every appliance for routine bacteriological investigation. This car also "contains an office, officers' and attendants' sleeping quarters and toilet rooms, and a kitchen and dining-room. It is lighted by electricity which also furnishes energy for driving fans and for heating an incubator." Irrespective of examination and record of results of sanitary surveys and bacteriological examination of 81 water-supplies, the car has proved of utility in an outbreak of cerebro-spinal fever. "The movements as a rule average about 50 miles, and the car lies at one point for from 24 to 72 hours."

The advantage of a Government Sanitary Service in the tropics possessing cars of the nature adopted by the U.S. Service is obvious, not only with reference to sanitary and bacteriological investigation in areas threatened by epidemics, but also in supplying *materiel* for public lectures where it is believed the procedure is likely to enlist popular aid.*

Delousing a Population.

Under Interstate Regulations preventive efforts against the importation of typhus from Mexico were instituted during 1917.† Travel by rail from El Paso by the Mexican labouring class or their families was not permitted, "unless they were provided with a certificate showing that they had been deloused, bathed, and vaccinated, and that their clothing and baggage had been disinfected." From the date of this ruling being enforced, no cases of typhus in the United States have been traced to El Paso.

The Mayor and Council of the City of El Paso welcomed measures for the repression of typhus. Under Asst. Surgeon J. W. Tappan, a scheme for delousing of the population was inaugurated. He secured a motor-driven omnibus and, with an Inspector of the Department of Health, made frequent visits each day to crowded Mexican tenements, conveying louse-infested persons and their personal effects to the service disinfecting plant where they were deloused. This measure resulted in a marked improvement "not only from the actual number treated at the plant but in stimulating all other Mexicans to bathe and boil their clothing so as to avoid being carried away for official delousing." These efforts were ultimately added to by issue of an ordinance regulating habitation of tenements and cheap lodging houses. A proposal to open free bathing houses and laundries fell through from lack of funds.

Interstate Sanitation.

Bolshevism in sanitation must be as hopeless of success under strain of circumstances as in politics. The smallest village community in a civilized nation cannot make rulings for its own protection against disease, without adapting these to the fact that its duty to self and the nation of which it is a unit is not limited by the village boundaries. *Sanitas suprema lex* may demand sacrifices of convenience or finance in obedience to the sanitary axiom that the minority must suffer for the majority. In the absence of organizations (supported by legislation and public funds) recognizing a common sanitary interest and sufficing to secure united efforts under a central Government sanitation may, according to some definitions, exist, but "prevention which is better than cure" *cannot*. It is in recognition of such facts that Great Britain is approaching the necessity for a Ministry of Health. In America, the United States Public Health Service is Federal in

* Major Justice, I.M.S., Sanitary Commissioner with the Government of Madras, has inaugurated a system of popular lectures illustrated by lantern slides. These, in form authorized by him, are delivered by Indian Assistant Surgeons.

† Annual Report of the Surgeon General of the Public Health Service of the United States for the Fiscal Year 1917. Washington: Govt. Printing Office. p. 226.

administration; abroad, its Medical Officers and American consuls man its outposts which supply rapid intelligence of disease movements. In its relation with the various States, it keeps touch with their respective health conditions and, whilst refraining from curtailing independence of action, arranges for affording material aid and guidance the moment interstate health is imperilled. In this spirit, the Interstate Quarantine Regulations of 1916 have been added to under an order approved (January 1917) by the United States Government Secretary of the Treasury, requiring that for sanitary administration purposes "no single State would be in more than one [sanitary] district."

Nor is it solely between States that this policy of co-ordination has been pursued. It is evident that permanent camps for troops under training, during the present war, must be placed in positions best suited for military purposes, and irrespective of whether legislation affecting the neighbouring civil population is suited to rural or urban necessities. Hence the necessity for a zone within which the civil population shall be required to conform to rulings which have for their purpose the protection of the health of the military population suddenly imported into their midst. Under the title of "Extra Cantonment Zone Health Legislation" suitable rulings have been framed (*Public Health Reports*, Dec. 7, 1917, p. 2079). These cover in considerable detail such subjects as venereal diseases, prohibition of disorderly houses, the sanitary care in production and sale of food stuffs, barber shops and hairdressing establishments.

Sanitary Dwellings.

To finance by a loan, recoverable as a tax on the security of a building, "private improvement expenses" is a procedure of great value, sanctioned by the Public Health Act of England, which should have considerable scope for utilization in tropical Municipalities. A proposal of kindred nature in the Report by the Government of Bombay on "Municipal Taxation and Expenditure in the Bombay Presidency for 1915–16" [p. 17] is thus referred to :—

"It may be of interest to note that the question of granting loans to municipalities and building societies registered under the Co-operative Societies Act, 1912, for the encouragement of house building on approved sanitary lines was considered by this Government in 1914–15 in view of a suggestion conveyed in a resolution moved by the Honourable Rao Saheb V. S. Naik at a meeting of the Legislative Council. One of the proposals submitted to the Government of India on the subject was that whenever the state of the finances permitted, advances should be placed at the disposal of municipalities, under the Local Authorities Loans Act, to enable them to finance schemes for the erection of dwellings on the areas developed by them, such advances to be conditional on the adoption of a prescribed standard of sanitation in the construction of these buildings. In view, however, of the present financial situation, the Government of India have decided to defer the further consideration of this proposal."

Town Development in Egypt.

A reprint from the "Town Planning Review," of April 1917, by W. H. McLean, M. Inst. C. E., conveys much useful information as to existing organization of public bodies in Egypt dealing with sanitation and public improvements, as well as affording details of town-planning pursued under his advice.

The most important Body is the Legislative Assembly, which is the Egyptian Parliament. Fourteen Provincial Councils undertake the duties of administration of local affairs. These correspond with the District and Local Fund Boards of India. They are allowed to "impose temporary local taxes up to 5 per cent. of the Land Tax"—as presumably levied by the Central Government. In 1915, these Boards had at disposal £E.603,000. They were thus in a position to support "Children's Dispensaries, Maternity Schools, Ophthalmic Hospitals, the filling-up of birkas (stagnant ponds), the creation and maintenance of agricultural roads, and the establishment and management of cotton 'halakas' (official local markets). Financial assistance has been given to other public bodies for various works of public utility. The educational work of the Councils embraces the establishment and control of elementary vernacular and industrial and agricultural schools, primary schools for boys and girls and training colleges for teachers of elementary schools."

In 48 towns, containing an aggregate proportion of 1,300,000 inhabitants, Municipalities have been established. Afforded in part by local taxation and in part by Government, their financial means suffice to "construct roads, public promenades, arrange for distribution of water and electric light, and a system of drainage in a large number of towns, where formerly none of these amenities or conveniences existed."

Two large towns in Egypt, namely, Alexandria and Cairo, are administered under peculiar conditions. In the former case, powers afforded the Municipality were formulated by 15 European Powers! That much advance has not been made by the Municipality is however not ascribed to inappropriate rulings, but "rather to errors of administration or inadequate supervision of the *personnel* than to inherent vices in the constitution of the municipal authority itself." As to Cairo, it possesses no Municipality, it being directly under the control of the Central Government—a condition analogous to New Delhi.

Markets.

Burma.—If the tropical dealer in petty goods and food articles be allowed to be a law unto himself, he ordinarily erects an insanitary shanty in an insanitary locality. Rival dealers flock to the same vicinity, and there results an odoriferous "bazaar." Throughout Burma, the custom (presumably founded in early days of independent rule) is for, practically, all petty dealers of a town to assemble in specially designed public buildings, so-called "markets" or bazaars. Whilst few of these markets fulfil sanitary ideals, they certainly present many facilities for sanitary management by public authorities, which scattered petty shops in poor localities of towns rarely afford. But this is by no means the sole merit of the method: to Municipalities, the discreet handling of the system becomes a source of profit. The Report on the working of the Rangoon Municipality for 1916–17 [p. 9] shows the total receipts from markets amounted to Rs.2,59,779.

Madras.—Although universally adopted in Burma, the use of public markets on a less scale is well known in other tropical and sub-tropical areas. For example, as stated in the preceding Note, "halakas" (official local markets) are a feature in Municipal administration in Egypt.

In the Madras Presidency, local markets owned by the Public Bodies of the areas concerned are fairly frequent, and tend usefully to displace private owned markets. The latter are not only subject to inspection by sanitary officials but are allowed, under licences which are not too lightly charged for, to "carry on" subject to sanitary requirements specified by the local authority being met at the expense of the owners. The accompanying plan* issued to Local Bodies by the Madras Sanitary Board (Government of Madras) shows a cheap type of rat-proof building for vegetable stalls in local markets. The slabs described as "polished" and "unpolished" Cuddapah slabs are derived from deposits of laminated limestone, and present an excellent surface for maintenance of cleanliness. Glazed tiles on reinforced concrete, cement concrete with polished cement surface and, lastly, hard wood for the vegetable platform, and floors of vitrified brick, wood blocks, salt glazed tiles, etc., present possibilities, according to funds available, where similar useful slabs are not procurable.

Sanitation of Jails.

Col. Buchanan, C.I.E., Inspector General of Jails, Bengal, in his Annual Report for 1916, calls attention to the results of the life saving methods steadily pursued in Indian Jails during a series of years. The general death rate per mille of average daily strength from 1860 to 1916, he quotes as follows:—1860, 132; 1861–70, 69; 1871–80, 59; 1881–90, 49; 1906–10, 23; 1911–16 (inclusive), 21. He claims that "in no tropical country in the world can a more progressive or considerable decline in mortality be shown."

In discussing cholera, he states [p. 20]:—

"Cholera nowadays rarely if ever obtains a footing in our Jails, yet it was once a very formidable factor in Jail mortality in Bengal as the following figures show:—In the ten years 1860–1869 the death rate among the prisoners from cholera *alone* each year averaged a rate of 16 per mille. This was rapidly reduced in the succeeding decades; from 1870–1879 it was 8·7; in years 1880–89 it was 5·5; in years 1890–99 it was 2·2; in years 1900–1909 it fell to 1·1, and since 1910 the rate has vanished to a small decimal point, viz., 0·2 per mille. Cases continue to be caught in the segregation wards in the Jails, among the new arrivals, but seldom or never does the disease spread, if ordinary precautions are taken."

Arboriculture.

The hygienic and economic aspects of arboriculture is a subject which with public bodies in the tropics is liable to fluctuations, in accord with the predilections of one or two members; as a constant factor in local improvements and politics, it is liable to be forgotten. In the Punjab, the care of arboriculture is fostered by the local government requiring definite statements as to progress made from the Local Boards of the Provinces. In the Report of District Boards in the Punjab for 1916–17, the Government notes:—

"The space devoted to arboriculture in the reports varies greatly, and in some the subject is not even mentioned. Eighteen miles of trees were planted in Gujranwala, 17 in Sialkot, and 13 in Lyallpur, but for most districts figures are not available. In Sialkot, the income from arboriculture reached the record figure of Rs.43,000, of which Rs.24,000 was clear profit, while in Gurdaspur the total income was Rs.21,000 and

* San. No. 98 of 1913.

expenditure Rs. 11,000. There seems to be no reason why other districts with an adequate rainfall should not find tree planting equally profitable."

[It may be explained that much of the tree planting by Local Bodies in India is undertaken on the lines of public roads for which they may be responsible, and that ornamentation and shade alone are not sought but commercially useful woods and fruit trees are cultivated.]

In the City of Madras, the Corporation Report for 1916–17 shows that the total number of avenue trees which are the property of the Corporation amounts to 15,296, and that 1,037 trees were planted during the year.

SANITARY RULINGS.

Queensland.

The Commissioner of Public Health for Queensland, in his Annual Report for 1917 [p. 6] is able to give details as to prevention of venereal diseases which show that, in contrast to the United Kingdom, mere debating as to measures which should be taken has given way to action —duly supported by legislation :—

"In this State additional legislation to that laid down in the '*Health Acts, 1900 to* 1911,' has been provided in the '*Health Act Amendment Act of* 1917,' which has considerably increased the scope of the Department in dealing with these diseases, by providing for (1) compulsory notification throughout the State, every person affected to place himself under a medical practitioner within three days of showing evidence of the disease and to continue treatment until certified as cured (special provision has been made for free treatment, so that no excuse can be offered when a delinquent is found); (2) the establishment of clinics in the principal areas of the State; (3) public hospitals to treat free of charge any case of venereal disease; (4) Wassermann tests are to be made without cost at the Department's Laboratory of Microbiology and Pathology for medical practitioners provided they furnish the required notification; (5) prostitutes to submit themselves for examination at certain centres. . . .

"Recommendations have been made to the Government to provide clinics at outside centres. . . .

"Prescribed forms of notification, on which the patient's name does not appear, as well as pamphlets dealing with the subject in respect to the patient and other phases appertaining thereto, are being issued. Small posters will also be provided for public urinals. Quacks and charlatans are banned under a heavy penalty from treating the disease, so it is hoped, with the assistance of the medical profession and the pharmacists, to carry out the new legislation so that every effort will be made in combating the greatest and worst of our social evils. . . .

"The cost of treating syphilis gratuitously must necessarily prove somewhat of a burden, but what is that compared with the cost of having to provide for lunacy, of which 10 per cent. is alleged to be due to syphilis, which disease also increases enormously our expense in connection with the blind. It is the bounden duty of the State to relieve the sufferer as well as to safeguard the unsuspecting future mothers of our population and their innocent and defenceless offspring."

Eugenics.

A proposed Act is at present under discussion in the Madras Legislative Council to be entitled the "Madras Children's Act." This follows closely the lines of the English "Children's Act." In the statement of "Objects and Reasons for the Act" (*Fort St. George Gazette*, Part 4, Dec. 18, 1817) the following essential point is brought into relief :—

"*Clause* 37 empowers the Governor in Council to provide for the establishment of juvenile courts in any district. The chief value of such a court is not, as is sometimes supposed, to protect children from the atmosphere of an ordinary court. This is a secondary object, and, in this country, is probably not so important as in England. The real value lies in the facilities given to the magistrate, who is not hampered by the procedure in force in the ordinary courts, to make a thorough inquiry into the circumstances which caused the child to be brought before him. He can then decide the best procedure to adopt—whether to send him to an institution or to deal with him in some other way. The parent or guardian is compelled to attend (clause 21). The ordinary magistrate has as a rule no time to make such an inquiry."

TREATMENT OF WASTE.

Soil and Nightsoil.

Lt.-Col. P. A. A. F. Eijken (Pharm. D.) and Dr. G. Grijns in the "Geneeskundig-Laboratorium" at Weltevreden, Dutch Indies, have recently conducted a research with the object of ascertaining the duration of persistence of intestinal microbes in soil.* They recognised that on this subject much information had been gathered in respect to temperate climates, but they anticipated that "given the immense intensity of micro-organic life in our eternal hot-house atmosphere" changes of a more rapid character might be expected in contact with soil. This they argued from their experience showing "how soon bodies of large animals are decomposed in our Malay soil, combined with the fact that very near to nightsoil pits you may find water wells very little polluted, even free from Coli." They selected, therefore, for investigation soil in the immediate neighbourhood of nightsoil pits (cess-pits) found in yards in the towns and suburbs. Within a short distance of these nightsoil pits, there were usually drinking water wells.

The authors state that, in the case of Europeans, the "water supply for the bathrooms is almost invariably a well; at a small distance off that room and near to the w.c. is the soil pit. So the well is often much too near that pit; the soil pit is ordinarily constructed with bricks not always set in mortar; sometimes concrete cylinders are used, rarely it is water tight." As to the native, they provide arrangements "extraordinarily primitive." "A hole of about a square yard surface and 1 to 2 yard depth is covered with a couple of boards or twisted bamboo wherein an opening, and a shed with bamboo walls around it. If the pit gets full it is covered up with earth, a new one is dug and the shed transferred."

It will thus be seen that the authors had ample opportunity of studying practically the problem stated by them. It was, however, complicated by the condition that in studying soil or water in the neighbourhood of a recognized pit, they might well, during soil exploration by a borer, find that another less recently-covered pit existed in close proximity. Such occurrences necessitated the elimination of data secured from their records. Again, observations during monsoon weather were so strikingly dissimilar from those found in the dry season that the authors determined to undertake a special series of experiments on the subject.

To secure, as a necessary preliminary, samples of virgin earth at different levels they used the "Fränkel ground-piercer" in various parts of Batavia. This was sterilized and inserted when cool. About 1 gramme of soil was used for the fermentation test, crushed with sterile water and put in Eykman fermentation tubes with glucose peptone saline solution, and incubated at 45° C. for 48 hours. They arrived at the conclusion that "in dry soil *B. coli* is absent at 0·5 M., while, under the influence of rain, it can penetrate to deeper layers."

Their next step was to ascertain the length of life of *B. coli* in sewage polluted water. They found that the Coli disappeared quicker

* *Med. Burgerlijken Geneesk. d. Nederl.-Indië.* 1917. Vol. 1.

than under similar circumstances in temperate climates, "that is, kept in bottles placed in a cupboard . . . the depuration proved to be surprisingly fast; out of 6 samples of well water 4 were Coli free after 9 days, the other 2 after 12." Summarizing their experiments the authors conclude on this section of their subject:—

"The recorded experiments show how our tropical heat favours the self depuration of water—faecal water included—and we need not be astonished to find in our further experiences in Indian soil the best conditions."

They then state the standard adopted by them:—"Bacteria that ferment glucose at 37° C. are found in all sorts of garden soil, even where faecal pollution is not probable. Therefore we adopt the 45° fermentation test in slightly alkaline glucose peptone salt solution as an indicator of faecal contamination."

Of their numerous experiments in the dry season it suffices to quote the following examples. At Kramat, no single fermentation at 45° C. was found, although at 3·5 and up to 5 metres there was fermentation at 37° C. At Koningsplein, of 21 wells, positive results at 45° C. were obtained only twice—once at 1·5 and once and 3·5 M.

At Tangerang road, "in wells at 1 M. distance from old w.c. pits fermentation is frequently lacking."

The authors draw the following conclusion:—

"As to the dry monsoon, from the observations now recorded, it is clear now that the pollution of the soil of which is talked so much in Indian towns, properly speaking it does not exist. One is rather astonished by the rate of purification the Indian soil is apt to. . . . Considering all the results obtained we are convinced that continuous soil filtration will prove here very well possible, and we advised in some cases to the construction of arrangements based on this principle."

The necessity for revising the method of experiment during the rainy season arose from the authors being convinced that a source of error existed in the ground piercer becoming wet and infected in passing through the soil, and not simply from the *B. coli* passing through the upper layer of soil with the rain. They therefore trusted to water obtained by pumping by means of Norton's tube wells which, instead of giving purely local results as with the Fränkel's ground piercer, secured averages showing bacterial and chemical conditions over larger areas. In thus stating their methods, they require it to be remembered that they did not desire to ascertain "the demands of good drinking water, but we have to state for each separate court whether the quality of the ground water near a leaking pit differs from that in the rest of the court, and how far the deterioration extends." In other words, the object of the authors was not to demonstrate the safety of cess-pits being side by side with drinking water wells, but to gauge the suitability of the local soil for sewage disposal, and to devise methods founded upon information gained.

As a result of a very large number of experiments necessitating both bacterioscopic and chemical examination, the following deductions were arrived at*:—

"If we survey the results arrived at till now, there is amongst all the courts that were examined with this method but one, where we could trace the pollution of the soil till about 5 M. from the pit. This is in the

* *Loc. cit.* pp. 144–145.

court of a Chinese cashier at Kampoong Passer-Bahroe. And for one single pit only.

"We saw that showers even when inundating the compound are unable to pollute a good constructed Norton well. There where the groundwater is not too high and the first watertight layer is deep enough even very near to the closetpit no contamination of the groundwater took place. The biological depuration of the soil is in most cases absolutely adequate to render faecal matter harmless at a very small distance from the night soil pit.

"In compounds where the watertight layer is high, and the groundwater level is only a few decimeters under the surface, the surface infection ordinarily is the determining factor for the contamination of the groundwater. The dirt that penetrates the ground with the surfacewater reaches the groundwater so quickly as not to leave time for biological depuration. But even in these circumstances generally a contamination parting from the pit can only be demonstrated at a few meters distance. It is a matter of fact that the horizontal extension of the biological reactions must be a larger one in such grounds, and also the dangerous circle round the pit. But as the groundwater in such compounds has already to be rejected for drink- or washing-purposes, this practically becomes no objection.

"Only where the groundwater reaches the surface or surmounts it by rains, a danger for infection originates by the contents of the pit entering the soil. In that case the soil should not be used for mineralising faecal matter. But then we should be already in grounds that ought to be declared uninhabitable also for other hygienic considerations.

"Seeing how in several compounds that differ much even geologically the biological actions of the soil are able to decompose big quantities of organic matter in a narrow space, and destroy intestinal bacteria too, we may expect this will hold also for other grounds than we met with here.

"We should think it imprudent however to conclude too much per analogy in a question so complicate and important and are investigations in it other grounds to be recommended. It is a constellation [*sic*] therefore, that experiments in connection with the sewerage projecting in Soerabaja could be carried out in that town, the geological formation of which differs considerably from that of Batavia."

The practical conclusion of the authors was that to secure purification of nightsoil, the most suitable course, in the locality concerned, was to present it to the soil in the liquid condition resulting from septic tank influence. For this purpose, they consider the septic tank latrines described in "Sewage Disposal in the Tropics" by Major Clemesha, I.M.S. (at present Sanitary Commissioner with the Government of India) as peculiarly suitable. The effluents of the tank latrine they conceived would be best disposed of by filtration as follows:—

"For the trench as well as for drains coarse riverstone or coral are to be employed to filling it till about 2 dM. below the surface; the upper part is filled with earth. It is to be recommended to place a thin layer of palm tree fibres (dooq) over the big stones, to prevent the sand from falling in. We dig the trenches about 1,5 M. deep when the watertight layer is not too high, making the bottom slightly sloping. The length of the trenches depends on the quantity of tank water we have to deal with, and the permeability of the ground."

The authors annex a plan of the latrines as suggested by them. They trust to the use of water by the users from a Norton tube well in the proximity of the latrine, and, as there is no mode of regulating the quantity employed or of air disconnection with the tank, as present in Silks septic tank latrines as improved by Major Clemesha, it is evident the septic tank principle, as adopted by them, is of the less elaborate nature used by the Kentucky State Board of Health [see this *Bulletin*, Vol. 9, No. 3 (Sanitation Number), Feb. 14, 1917.]

Finally, they afford evidence of the extent of soil pollution at the end of one year's use of these latrines, which is thus summarized by them [p. 153]:—

"Near w.c. No. 1, where the next well is at 5 M. distance from the tank outlet we can not disguise [? discover] a trace of soil pollution after a year. Near w.c. No. 2 in well 1 at 4, 5 M. distance a slight influence is sensible after a year. We find the number of bacteria a little higher (25) and fermentation in all three experiments till 1 cc. Here the coli-figure is rising.

"As we did not construct an automatical control installation in account of the costs, we can not tell the number of persons who made use of the w.c.'s. However for a week we had observed the w.c. 1 and 2 from 5 a.m. till 9 p.m. and found for No. 1, 24, for No. 2, 41 visitors per day.

"W.C. No. 3 has 4 seats against 2 in the other ones, and is surely the most frequented. Here the wells were 1,5 and 2,5 M. from the tank. On this small distance pollution is seen very clearly. This won't surprise us, as biological depuration has to occur not in the drains but in the soil, and some space is necessary for that purpose."

Type Conservancy System.

If the excreta of a population of, say, 10,000 is to be removed by means other than by some form of water-carriage system, and the locality be not unsuitable to transport by carts or tramways, it should be possible, within the limits of variation due to distance of sites of deposit, to arrive at a closely approximate calculation of the plant required and its cost, and to deduce reasonably safe proportionate calculations for smaller populations. In recognizing this principle, the Government of Bombay, in its Review of Reports on "Municipal Taxation and Expenditure" for 1915–16, [p. 10] quotes, with approval, the following remarks of the Commissioner, Northern Division:—

"'As there did not exist in most of the municipalities satisfactory arrangements for the speedy and complete removal of all night-soil and rubbish from the vicinity of habitations and its disposal, the importance of which has been emphasised in a recent resolution of the Government of India, the Deputy Sanitary Commissioner was asked to work out a definite standard of sanitary appliances and conservancy establishment necessary for a town with a population of 10,000 souls. This has been forwarded to the Collectors in Gujarat, and they have been asked to advise the municipalities in their districts to set their towns in order by revising their arrangements in proportion to that standard.' This action of the Commissioner commends itself to the Governor in Council, and he accordingly desires to bring it to the notice of the other Commissioners."

Sawdust for Urine Filtration.

In the *China Medical Journal* of May, 1917, Dr. Arthur Cole and Dr. E. Muir of Kalna, India, quote facts supporting the late Dr. George Vivian Poore's testimony to the utility of sawdust as a deodorant, when employed for urine filtration. Dr. Muir gives a description [p. 217] of a method of utilization affording excellent results:—

"We therefore constructed a urinal for our hospital on the following lines, and are surprised and delighted at its success, which removes a terrible nuisance. A small room about six feet by six was constructed, with a corrugated iron roof. Along the west side was a trough containing sawdust and sloping towards a pipe which drains into a canister outside the house. East of the trough is a step about three feet broad sloping slightly towards the trough, and having three pairs of level bricks, cemented

over, on which the patients can place their feet when passing urine in the squatting position. This step is about fifteen inches high, so that the trough is fifteen inches deep and contains about a foot of sawdust. . . . Although this urinal is in constant use and water constantly dripping out of the pipe into the canister, we are surprised to find absolutely no smell. The water in the canister is brownish in colour from the wood, but has absolutely no smell although it stands for a couple of days. The whole building is cemented. Since it was constructed, our hospital has been a different place with regard to smells."

SANITARY WORKS.

Water-Supply of Cantonments.

Before the war Americans proved that standardization, as applied to anything from motor cars to bridges, contributed to economy and rapidity of outturn. To shelter their recently assembled large armies, during training, has necessitated the erection of semi-permanent camps, where both these conditions are essential. Instead therefore of following the British principle of allowing the authorities of localities concerned to seek from the tangle of local opinion compromises in the designing of water schemes of each camp, they from the outset laid down certain principles for observance. Where details could appropriately be defined, these were also pre-determined; so that whilst the specifications were capable of relaxation to meet varying topography and other conditions, there were fixed definitely the type plans of camps, location of mains, hydrants, distribution pipes and the service pipes for each building; and there also were prescribed certain sizes of mains for each set of conditions that could reasonably be anticipated.

The type camp has been planned to accomodate 40,000 men. In an article on "Water-supply and Specification for the National Army" (contributed to *Engineering News Record* (New York), 1918, Jan. 3, by Dabney H. Maury, Consulting Engineer for Water-Works) the advantage of this system is emphasized by the statement that whereas, in ordinary times, for a civil population of this number, the planning and completing of waterworks would take about three years, 16 Army Cantonments have been planned and completed in a little over three months. Economy was largely contributed to by about 70 per cent. of the total mains being wood stave pipes instead of cast iron; the cost of the former being "on the average 60 per cent. of that of cast iron pipes. These pipes were calculated to be capable of sustaining a pressure of not less than lbs. 60 or more than lbs. 85 per square inch. They were specified to be "of the machine wound type, so that the pipe may be shipped already made up." Under ordinary conditions of pressure the use of 12 inch mains is contemplated. The type scheme requires—

"two lines of water mains running the length of the cantonment. If the supply be delivered into the distribution system at one end of the line of units, there should be two mains leading from the supply through the line of units and looped together at the far end. If the water enters at or near the centre of the cantonment then the two mains which run the length of the cantonment should be looped at each end.

"Provided always that the initial pressures hereinbefore specified in Article 6 are at all times available, and provided further, that the spaces between the separate units are not materially greater than those shown in the typical general plan, and assuming that there will be no elevated storage available, then if the supply be delivered at one end, the cantonment will require two 12 in. mains running throughout its length, while in a cantonment with centre feed these two mains will be 10 in."

* * * * *

"If elevated storage can be obtained to tide over the maximum drought period the size of the mains would be susceptible of reduction."

In consideration of the well known tendency of American civilians to an extravagant demand for water, the supply arranged for these

camps is at the rate of 55 galls. per head. But it has been found under conditions of discipline and, therefore, the power of guarding against waste, that plenty of water is available at 30 (U.S.A.) gals. per head.

In camps where the total supply is a matter demanding care, or where full available pressure is necessary to serve the more elevated parts, the following rulings securing that heavy demands shall not not be made simultaneously upon the supply systems, should be useful in our camps in the tropics as a routine measure, irrespective of a "fire alarm":—

"(a) All fixtures shall be shut off when not in actual use; (b) the fire drill regulations shall make it the definite duty of certain designated individuals to shut off, as soon as fire alarm is sounded, every fixture from which water may be drawn for purposes other than fire fighting, except those necessary for cooking purposes; (c) the several brigade units in each cantonment shall make use of the showers at different hours, so that the very heavy peak load resulting from the simultaneous use of all the showers may be avoided; (d) the use of water for sprinkling roadways and grounds, and for the animals, shall be so timed as not to coincide with the peaks resulting from the heavy draught for the showers."

Makeshift Waterworks.

The world demand now is and, in the "after the war" period, will be, heavy for iron and, consequently, cast iron pipes will be costly; with the probable result of delaying the execution of public waterworks. Irrespective of this fact, the sanitarian in the tropics is liable, when advising a protected public water-supply of however simple a nature, to be confronted with the difficulty which transport of such heavy material as iron pipes implies. Must therefore a minor water-supply scheme be indefinitely postponed till transport is organized on the lines of an advanced country? Is it possible to secure methods of a makeshift type that will serve the purpose reasonably well till better times permit? For example, would it be possible to introduce, with reasonable sanitary safety, into a small town or village a water-supply under pressure without the aid of iron pipes? If this query is confined to the question of mains, the answer can be in the affirmative. In the scheme for distribution of water, the absence of small pipes and fittings would present difficulties, which however would not be insurmountable.

Wood stave pipes.—Putting aside reinforced concrete as entailing the use of iron in various forms, the employment of wood pipes suggest itself. Of trees merely hollowed out and fitted to each other end to end by bevelling, the London of olden days affords instances; wooden pipes so used are at intervals disinterred in good condition. But it is to America that illustrations of modern examples of use of wood must be looked for. For example, the extensive use of wood stave pipes is referred to in the preceding Note—"Water-supply of Cantonments."

In a paper (quoted by *Indian Engineering*, Calcutta, 1917, Dec. 1, p. 305) by Mr. Partridge, embodied in the Proceedings of the American Society of Civil Engineers, it is stated that Balsa wood (*Ochroma lagopus*) is that most approved for the purpose, but that cypress is practically as lasting; fir is also employed. The fear naturally would be that the longevity of wood stave pipes would be brief; but Mr. Partridge gives instances of pipes lasting under varying conditions up to 25 years. He also refers to instances of 13,550 ft. of

40 in. and of 26,300 ft. of 36 in. wood stave mains, working under a maximum pressure of 295 ft. and a minimum of 150 ft. The line is "underground through alkali flats, but where deep ravines are crossed it is carried exposed on trestles." These pipes were laid for San Diego and Coronada, in California, in 1900; examination in 1916 showed they were in perfect order.

These statements suffice to prove the durability of wood stave pipes for large mains where cast iron is not readily available; but a second type is also manufactured for pipes from 2 to 24 inch diameter. These are "factory made," and are capable of withstanding a pressure up to 400 ft.

"The sections are from 8 to 24 feet long and have the necessary couplings or collars for connecting them. The staves are generally kiln-dried and are banded with galvanized wire from No. 6 to No. 00 gauge, spaced according to pressure, and fastened to the pipe with pressed steel clips or staples. Each section is dipped in asphalt and rolled in saw-dust, the asphalt effectually covering the wire and staves, and the adhering saw-dust permitting the pipe to be handled readily. The sections of light-pressure pipes are joined with inserted or slip-joint connections, being sometimes reinforced with a steel band equipped with a shoe for cinching tight."

Whilst the longevity of wood staves is of the good duration noted above, both in air (supported on trestles) and below soil, it is evident from a statement of experience made by *Engineering News Record* (New York), Dec. 27, 1917, p. 1204, that care is requisite as to nature and depth of the trench in which wood stave pipes of large diameter are laid. The limit is thus defined:

"Where the sides of redwood pipe can be held firmly in place so that the horizontal diameter cannot increase, then 1½ in. redwood staves are capable of safely supporting under the most severe assumed condition of loading a mud fill slightly more than 2 ft. in depth over the top of the pipe. If the staves are 2½ in. in thickness this depth of fill can be safely increased to about 6 feet."

The present day wood pipes are built of staves air dried. For Balsa wood no internal coating is necessary, but firwood pipe staves are well preserved by a coating of tar and asphaltum. Steel bands are used and so spaced "that they will have a safety of form against breaking due to tension caused by the water pressure."

Earthern pipes.—Unglazed pipes of the character of agricultural tiles would certainly present little prospect of conducting water under pressure. This however was not the opinion of the Engineers who under Malik Umber (Regent and Minister during the minority of the Emperor Shah Jehan) in the 16th century, formed the remarkable water-works at Aurungabad in the Hyderabad Territory (Deccan). They used unglazed pipes for their mains, but took the precaution of surrounding them *in situ* with lime concrete. Practically, the earthern pipes merely formed the lining of concrete pipes.* Although here and there, in the lapse of centuries, the pipes have yielded, the bulk to this day perform their duty.

* It is possible that the excellence of the concrete was contributed to by the use of "jagghery" water—that is, a solution of crude cane sugar. Its use may perhaps be futile; but old masons in the Deccan have, to the writer's knowledge, faith in this combination. The subject of what, if any, new combination or modification of conditions results from the mixture is worth pursuing, when "sugar coupons" are no longer necessary.

The object of the writer in referring to these pipes is to suggest that in areas in the tropics where a village potter can form and kiln earthern pipes, and where there is fuel (say, charcoal made on the spot) wherewith to make lime from chalk, limestone, shells or coral, and, in the absence of suitable stone, for the burning of bricks, the sanitarian can undertake makeshift waterworks of real utility. Typically, a Medical Officer with jail labour at disposal should, in localities where no Engineer is available (and still less iron pipes), be capable of supervising the whole of the necessary details.

But having obtained pipes, there would still remain the difficulty, if water is to be introduced into an inhabited area correctly protected from contamination, of obtaining service pipes of small diameter. Here, if short lengths of iron pipes be provided, the total demand need be but of a limited nature. In their absence, it would still be possible to fall back upon the small wood wire-bound pipes above referred to. Failing these, closed masonry cisterns above and below ground level of various designs provided with taps will suggest themselves as aiding this end, according to the topography of the site.

Malik Umber's Engineers made cisterns, so called "Khazanas" (treasuries), which were central distributing points for supply of consumers as in figs. 1(a) and 1(b). The distribution was conducted by "nuldars" (pipe-men) who held hereditary office. They closed the orifices of outlet pipes (shown in the plan of "Khazanas") or placed bricks at angles which long practice had proved would permit the passage to a consumer of a definite amount in a definite time.

So far then as to pipes; but the question of these earthern pipes (notwithstanding their concrete exterior) resisting pressure remains. This could be met by employing the simple yet ingenious system of "break-pressure columns" adopted on the Malik Umber Works above referred to. The principle under which these act will be self-evident from the annexed plan, fig. 2.* By repeated use of these on a pipe line on a descending gradient, the pressure can be reduced at will. It is understood similar columns are found on old waterworks near Constantinople.

Cost of Water.

From the note under Sanitary Works in this number relating to cost of pumping for water supplies of towns, there are afforded data for contrasting the economy of the various mechanical methods employed. The homily to the taxpayer as to waste may be aided by quoting the actual cost thus exhibited, but conviction should be more readily thrust home by the reminder that it is not only in introducing water to a town that cost is incurred but also in getting it safely disposed of in the form of sewage. Mr. Maloney, I.C.S., the

* A further instance of knowledge of engineering hydraulics in the Malik Umber Works is exhibited in the use of the syphon principle in conveying the water across the river Unsool as shown in fig. 3. This crossing of the river to reach the City of Aurungabad emphasizes the fact that the intention of the infiltration gallery was to intercept the subsoil water *en route* to its natural outlet, as exhibited by the trend of the country. In the old local palaces, fountains and cascades were employed from the supply.

FIG. 1 (a).

Section (A—B) through "Khazana," or storage cistern regulating distribution in defined areas.

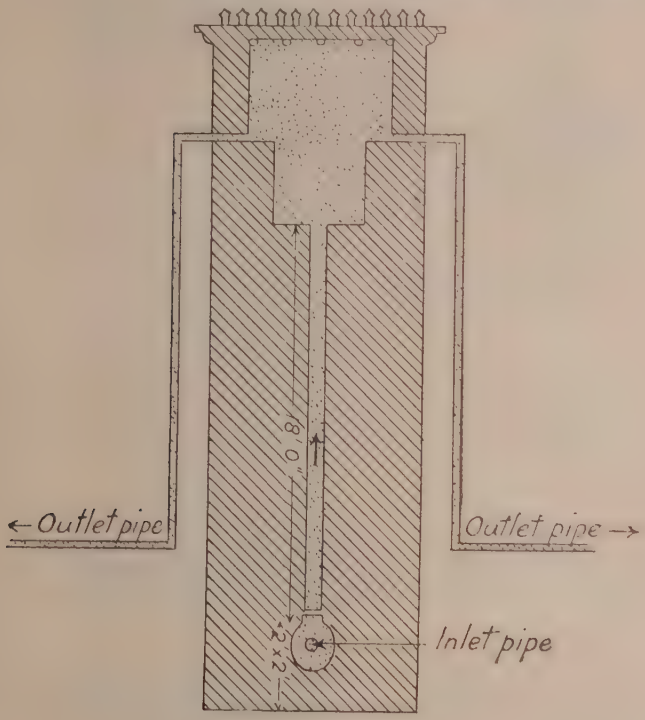


FIG. 1 (b)

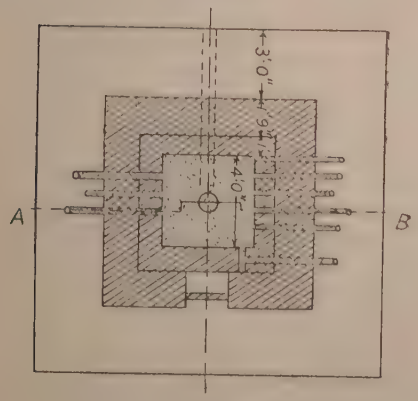


Fig. 2.
Section of Break Pressure column. Scale 9 ft = 1 in

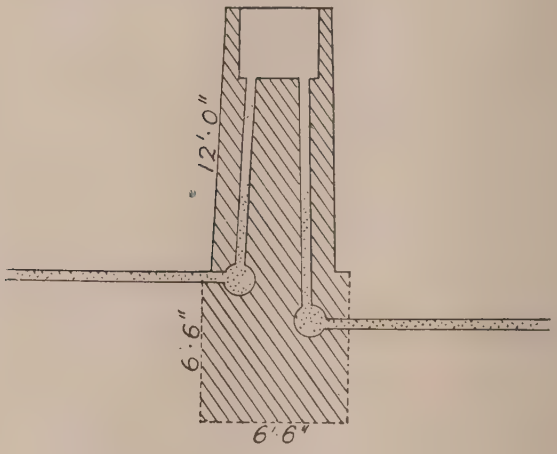
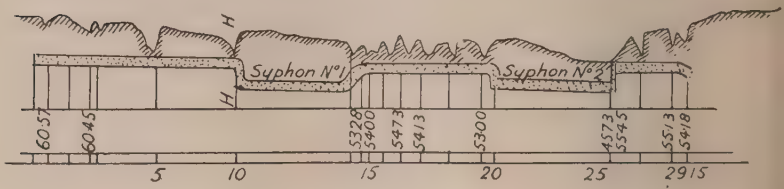
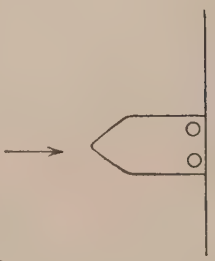


Fig. 3.
Longitudinal Section of a portion of Main Tunnel showing both Syphon



Scale { Hor 800' / Ver 80' } to = 1"

Section of Tunnel at H.H. showing face of Syphons. Scale 10'=1".



President of the Corporation of the City of Madras, thus calls attention to the subject* :—

"The financial stringency has resulted in a close examination of the cost of supplying water to the City and the economies that may be effected. These were fully dealt with by the Special Engineer in his report, dated 22nd July 1916.

"He concludes that the water costs are as follows:—

	Cost in annas per 1,000 gallons.
Paid to Government for supply at Red Hills ..	0·01
Conveying from Red Hills to Kilpauk	0·01
Filtering at Kilpauk	0·05
Pumping at Kilpauk	0·36
Distribution through city	0·25
Total for maintenance only	0·68
Add for depreciation and interest on capital ..	1·48
Total cost per 1,000 gallons, annas ..	2·16

"This is the cost of the water pumped into the mains, but as at the present time two-fifths of the water is wasted or used for unremunerative purposes, the cost charged against water paid for has to be increased in proportion and when thus corrected it becomes 3·6as. per 1,000 gallons.

"But the water costs the Corporation more than this, for it forms sewage which costs as.3·54 per 1,000 gallons to remove and deal with. The total cost of providing 1,000 gallons of water and dealing with it as sewage is as.5·7 per 1,000 gallons. From these data a simple calculation shows that every gallon of water wasted per head per day in the course of a year costs the Corporation Rs.65,000 to provide as water and deal with as sewage."

The Cost of Pumping.

Failing the possibility of securing a public water supply by means of a gravitation system, authorities in the tropics are apt to reconcile themselves to the absence of any scheme which entails pumping, on the vague ground that the cost would prove "prohibitive." Doubtless this is frequently the case ; but no such conclusions should be accepted without careful estimates being prepared. Hence data gathered under observed conditions in the tropics are of value. In the Madras Presidency, at water-works where pumping is employed, records are maintained which supply statements of the type of machinery used, fuel consumed, amount of water pumped, height to which lifted, etc. These records are systematically scrutinized as to their reliability by the Sanitary Engineer to the Government, and his staff during periodical inspections. The results ascertained during 1916, recorded in the following table † (as given in the Twenty-Seventh Annual Report of the Sanitary Engineer, p. 54), are likely to be of utility elsewhere, if local cost in any particular locality be applied to the amount of fuel stated :—

* Administration Report of the Corporation of Madras for 1916–17. 1917. Madras : Printed by Thompson & Co. pp. 28–29.

† Abbreviated by omission of names of stations, total quantity pumped, and totals of fuel used, during the year.

Statement of the Results of Pumping at Certain Water-Works in the Madras Presidency possessing Pumping Plant.

Stations.	Average lift.	Description of fuel.	Pounds of fuel consumed per 1,000 gallons.	Cost per million gallons raised 1 foot high.	Pounds of fuel consumed per pump horse-power.	Remarks.
1	3	5	6	7	8	9
	ft.		lb.	Rs. a. p.	lb.	
A	70·00	Liquid fuel	0·34	0 5 3	0·97	Diesel oil-engines with belt driven, geared Worthington Triplex deep well pumps.
B	70·75	Coal	7·05	1 14 6	19·74	Hathorn, Davey Horizontal compound surface condensing engines and pumps.
C	49·32 **48·91**	Do.	3·34 **3·60**	0 13 10 **0 14 6**	13·16 **14·34**	Horizontal direct-acting Worthington compound surface condensing.
D	45·68 **43·93**	Do.	2·15 **3·13**	0 11 10 **0 13 1**	9·33 **14·73**	Horizontal direct-acting Worthington compound engines and pumps.
E	53·55	Kerosine oil	1·21	1 1 10	2·51	Hornsby Akroyd oil-engines with belt

H	46·99 **42·36**	Coal	2·18 **2·20**	0 11 10 **0 13 5**	9·20 **10·29**	Horizontal Worthington direct-acting triplex expansion engines and pumps.
I	148·13	Do.	4·82	0 12 1	6·44	Vertical Worthington direct-acting triplex expansion engines and pumps.
J	66·34	Kerosine oil	0·33	0 7 11	0·99	Hornsby oil-engines with belt driven Worthington Triplex geared deep well pumps.
K	29·95	Do.	0·44	2 10 2	2·90	Hornsby oil-engines with belt driven Worthington Triplex geared pumps.
L	83·95 **81·76**	Coal	2·71 **2·36**	0 9 2 **0 10 10**	6·40 **8·34**	Vertical Worthington direct-acting Triplex expansion engines and pumps.
M	100·88 **98·74**	Do.	3·82 **2·93**	0 9 3 **0 10 0**	7·53 **8·32**	Do. Do.
N	61·73 **64·54**	Do.	4·99 **5·10**	1 5 8 **1 6 3**	15·55 **15·55**	Horizontal Worthington direct-acting Triplex expansion engines and pumps.
O	207·59	Do.	7·81	0 7 9	7·45	Vertical Worthington direct-acting Triplex expansion engines and pumps.

[*Note.*—Figures in *thick type* are averages for eleven years.]

Prevention of Water-Waste.

The Sanitary Engineer to the Government of Madras (Superintending Engineer, W. Hutton, D.P.W.) gives in his Annual Report for 1916 [p. 50] the following opinion as to the importance of using meters for controlling waste of domestic water supplies :—

"Owing to numerous complaints from the general public of deficiency of supply at public fountains, the policy of metering house connections was brought forward a few years ago and the results, so far as they have gone, have amply justified the introduction of this policy. Formerly it was almost impossible to detect waste of water, the only evidence being the admitted deficiency at public fountains while the records of the head-works showed that a sufficient quantity of water had been sent to the town.

"Now about twenty-five per cent of house connections have been metered and this has resulted in a more equable supply to the other houses and to public taps.

"The policy of metering these connections is not a popular one, but it is essential if any systematized and equable supply is desired. The free allowance of water granted under the by-laws of a municipality is ample for ordinary requirements and the extra charge for excess water used for a domestic supply, twelve annas per 1,000 gallons, is low and should not affect the bona fide use of water from a municipal water-works. It is essential that the policy of the introduction of meters should be persisted in, and the rate of introduction of meters accelerated. The cost of the meters, it has been found, is usually recouped to the municipal council in a few months, while the reduction of quantity of water used in a house is very evident. This reduction, it should be remembered, is not, as some say, usually interested parties, due to the stinting of the supply but practically represents the saving gained by the closing of house taps by consumers, when the required quantity of water has been drawn off."

Water Purification Plant.

Storage and methods of purification in connection with public water supply systems in the tropics present many unsolved problems. Systematic investigation for some time past has been conducted on these subjects, under the auspices of a Committee appointed by the Madras Government. The members are—the Surgeon-General with the Government of Madras (Surgeon General Bannerman, C.S.I.), the Sanitary Commissioner for Madras (Lt.-Col. Justice), the Director of the King Institute (Dr. Maitland Gibson) and the Sanitary Engineer to the Madras Government (Superintending Engineer W. Hutton). In his Report for 1916 the last-named Officer makes the following remarks on the subject* :—

"The works are unique in that they are believed to be the only ones of their kind in India, and the object of them, the obtaining of knowledge by actual research work under tropical conditions, was advanced during the year in a number of ways. At present the results of protecting a sand filter from the sun by a light roof has proved most interesting and valuable, and the effect of the sun on storage in a tank for some days will, it is believed, show that the storage of water in tanks for a certain number of days in the hot weather results in its sterilization under the effects of an Indian sun.

"The experimental works are maintained in a highly efficient condition, as is necessary with such investigation works, and they form an interesting addition to the King Institute of Preventive Medicine.

"It is proposed to recommend to Government that the operations should be continued for another year."

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* Madras. The Twenty-Seventh Annual Report of the Sanitary Engineer. 1916. 1917. Madras: Printed by the Superintendent, Government Press. p. 52.

Water Purification.

In this *Bulletin* (Sanitation Number) Vol. 10, No. 1, July 15, 1917, p. 34, note was taken of the important work in connection with the laboratory control of water purification plant on the Panama Canal. A further Report for 1916–17, in continuation of the results secured, by Mr. G. C. Bunker,* the official Physiologist, and his skilled staff has now been issued. The details afforded are of an elaborate and exhaustive nature, so that, irrespective of special points which have been now elucidated, there remains a mass of data to which mere repetition in course of time may add weight and which may prove of utility in dealing with various still unsolved water purification problems. The work fulfilled covers an experimental study of adaptability to requirements of apparatus and filter media in water purification plant, as well as identification of low organisms and the chemical and bacteriological conditions encountered. In the interests of space, it is necessary to confine attention to data concerned with present day practical methods.

Free carbonic acid as a money waste factor.—The filters employed are of the rapid sand type otherwise known as "mechanical filters" or "American filters," which terms are used in contrast with the "slow sand" or "British filter." This type necessitates the formation of an artificial film with aluminium hydrate and an acceleration of speed under pressure through the filter, much beyond that attainable or desirable by gravitation through slow sand filters. Without discussing the comparative merits of the two systems in arresting water borne microbes, it may be said that if the filter material on the rapid system is to perform its function efficiently washings must be frequent, and, this being so, in localities where either the total available quantity of water dictates economy or the necessity for lifting it involves expense, it is not a method that can be adopted without careful weighing of the pros and cons. Any arrangement by which the cost of labour and expenditure of water can be decreased must therefore be of value.

In the *Bulletin* above referred to the influence of aeration upon carbon dioxide, as found by Mr. Bunker, was quoted. He now shows that the process is of value in removal "by aeration of free carbonic acid liberated by the formation of aluminium hydrate, thereby reducing the amount going on the filters and increasing the length of the filter runs." If the free carbonic acid is thus formed and spraying could diminish it, a natural deduction was that the alum should be added to water before it passed through the spraying nozzle. Acting on this opinion Mr. Bunker directed that the alum should be applied at the inlet end of the aeration basin, instead of the outlet as hitherto practised.

"The results effected by this change in treatment have been, as follows: (1) Reduction of free carbonic acid in the settled water applied to the filters; (2) increase in length of filter runs; (3) decrease in the number of filters washed and the percentage of wash water; (4) reduction in running hours of two air compressors."

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*MS. Report on Operation of Purification Plants, Inspection of Reservoirs, and the Laboratory Control of the Water Supply in the Canal Zone. Fiscal year ended June 30, 1917. Prepared by Geo. C. Bunker, Physiologist to the Panama Canal.

Mr. Bunker furnishes a table showing that "as compared with the previous fiscal year, there was a decrease of 729 in the number of washings with a resultant saving of 39,639,000 gallons of wash water, a 44·5 per cent reduction."

Jar experiments by Mr. H. F. SCHMIDT gave the following results as to free carbonic acid.

Grains per gallon of alum.	P.P.M. of free carbonic acid liberated		Variation.
	Jar experiments.	Theoretical.	
0·5	3·0	3·4	—0·4
1·0	6·0	6·8	—0·8
1·5	8·3	10·2	—1·9
2·0	11·5	13·6	—2·1
2·5	14·8	17·0	—2·2
3·0	18·1	20·4	—2·3

Alum and lime treatment.—But obviously aeration was not the only method open for getting rid of excess of carbonic acid :—

"In order to secure a final water with a colour of about seven parts and an iron content of about 0·15 part, it has been found that the water must be so treated with alum in the first sections of the settling basins as to enter the second sections with an iron content of that desired in the filtered water and a colour of two or three parts less, for the lime increases the colour of the settled water through its action on the flock.

* * * * *

"It was found feasible to neutralize all of the free carbonic acid in the settled water and to add 5 to 10 parts of normal carbonate alkalinity ($CaCO_3$) and at the same time to reduce the colour of the filtered water to 7 to 10 parts and the iron to less than 0·3 part. This method of treatment possesses the following advantages :—

"1. The lengths of the filter runs are increased to an average of 65 hours, and the per cent. of wash water reduced.

"2. The cost of operation is reduced.

"3. The rate of the corrosive action of the water on galvanized iron and lead pipes is slowed up.

"4. The multiplication of bacteria in the second section of the settling basins is limited.

"5. A reduction in the bacteria in the filtered water results during the period of storage between the time of pumpage of the water from the plant and its withdrawal from the distribution system by consumers.

"The disadvantages are :—

"1. A faint flat taste results from the removal of all the free carbonic acid, which is not noticed by the average consumer.

"2. An excess of normal carbonates leads to the formation of a soft cream coloured deposit in galvanized iron pipes of which the rapidity of the accumulation increases as the rate of circulation through the pipes decreases.

"3. The hardness of the water is increased about 10 parts, making a total hardness of about 26 parts.

* * * * *

"On account of the low colony counts in the sludge from the 2nd sections of the basins, presumably due to the bactericidal action of the mixture of lime, it was thought that the multiplication of bacteria in the settled water was occurring during the passage through the first sections of the basins and that, after the addition of the lime at the baffles, no further multiplication would occur in the second sections. In order to obtain some information about this point, samples were collected from

the settled water in the first sections, prior to the addition of the lime, and from the final effluents of the second sections as they entered the filter box.

"Of the 23 samples examined, all except three of the lime treated settled water showed a decrease in the numbers of colonies of bacteria as compared with the corresponding samples of the settled water prior to the addition of lime. While the data is insufficient for preparing a definite statement as to the degree of bactericidal action of the lime in the second sections of the basins, the conclusion may be safely drawn that the multiplication of bacteria in these sections is prevented as long as normal carbonates are present. The decreases will vary, of course, according to the periods of subsidence in the basins."

Treatment by chlorine. An experiment was made of using liquid chlorine in the water after filtration and before filtration, respectively. In the former case, it was found that—

"the maximum amount which could be applied to the water, without imparting a chlorine taste to the water in the distribution system, was 1·75 lbs. per million gallons, or 0·21 parts per million of available chlorine. . . . While a satisfactory reduction of the bacteria in the filter effluents resulted, namely, from a monthly mean of 304 to 4 colonies per cc. in the sterilized water samples collected from the discharge of the pump, a multiplication occurred in the distribution system, so that the average of 90 samples collected in Cristobal and Colon was 100 per cc."

In the treatment by chlorine prior to filtration, at first 0·36 parts per million of available chlorine was employed, but as this imparted a taste to the filtered water it was reduced to 1·9 pounds per million gallons.

In 28 samples of water giving 365 colonies per cc. there was a reduction prior to passage on the filter to 25 per cc., but, as the water went through the filters, 30 samples gave 1,411 per cc., and of these 70 per cent. gave colonies above 1,000 per cc. In the distribution system, a reduction occurred of 90 per cent. giving a mean of 963 per cc.

On these results Mr. Bunker remarks :—

"As long as the species of bacteria, which multiply in the filters, are present even in small numbers in the wash water, they will be constantly returned to the filters and act as 'starters.' Therefore as long as sufficient chlorine cannot be added to the water, on account of the production of a taste or odor, to insure a permanent sterilizing action, a multiplication of bacteria will occur in the wash water tank. To eliminate the bacteria which multiply in the filters at this plant they must be washed with a wash water which is sterile or nearly so."

Water-Supply as an Anti-Malaria Measure.

A public water-supply system which can dispense with any form of impounding reservoir or filter, is protected throughout the course of its catchment, needs but little use of pipes beyond its distribution system, and dispenses with pumping, should be ideal both for sanitary and financial reasons. These virtues are more likely to be found combined in a system which looks to an infiltration gallery as its source than any other, as presenting to the sanitarian in the tropics, with solely indigenous skill at his disposal, the best opportunity of making a successful makeshift water-supply for a village; or still better a combined anti-malaria and water-works scheme. The simplicity and effectiveness of the methods involved in the use of infiltration galleries naturally appealed both to engineers and agriculturists of by-gone days. They are found as the sources of ancient

water-works in Spain, Turkey and India. In Afghanistan and Italy, they occupy as irrigation-works an important place in cultivation. Probably the Malik Umber water-works of Aurungabad, referred to in the preceding Notes as to makeshift pipes, affords one of the best examples. Here, the requirements of an area of ground sufficient as to catchment in relation to the rainfall, capable of percolation and possessed of a trend towards the natural outlet for subsoil flow are obvious. Malik Umber's Engineers taking advantage of these conditions ran the gathering gallery *between* the catchment area and the river Ursool so as to intercept the subsoil water—thus avoiding the mistake at times made, in the present day, of trusting to percolation *from* the river.

Mr. W. MARRETT, late Chief Engineer, Nizam's D.P.W., in an Official Report (1895) forwarding a water-works scheme for the Cantonment of Aurungabad incidentally refers to these ancient works (at that time supplying the City) as follows :—

"The work consists of a subterranean infiltration gallery 9,400 ft. in length, very irregular in shape and dimensions, having a width of 2 to 3 ft. and a height of from 6 to 10 ft. The floor is 12 ft. below the bed level of the Ursool river, which flows by its side. The roof is a brick arch supported on the porous trappean formation, which forms the sides of the gallery. Shafts called 'Roshundans' [light holders] communicate with the surface at intervals of 200 to 300 ft. The catchment area of the water bearing stratum is 12 square miles. The gallery intercepts* the spring flowing subterraneously to the river, the natural outlet of the valley."

The similarity of the work as described by Mr. MARRETT with that of the same class found in Italy, will be apparent by reference to Figs. 4 and 5 from the paper on "Italian Irrigation," by Luigi LUIGGI (Professor of Hydraulic Engineering, Royal University of Rome) read at the Meeting of the International Engineering Congress of 1915, at San Francisco. That authority states that "some parts of the Roman Campagna, and also around Naples, are literally honeycombed with a network of narrow tunnels (a great many of Etruscan and Roman origin are still in working order) that collect and bring to the surface at a lower level the rain water that percolates through the fissured volcanic formation of these regions." In referring to "the large volumes of water flowing underground from the lakes or the mountains to the river Po," he states that, "the water can easily be tapped by ordinary wells of about 20 or 30 feet diameter and conveyed by a deep cutting to the surface of the fields at a lower level."

Prof. LUIGGI's reference to the network of tunnels in the Roman Campagna should recall the contention of Tomasi CRUDELLI that these formed, in their effect upon the subsoil water, the real protection from malaria of the areas near Rome during the prosperity of the Empire, until their disrepair favoured malaria production.

The holding in mind of the principles involved in these old works may well enable a sanitarian to advise an interception trench, gallery,

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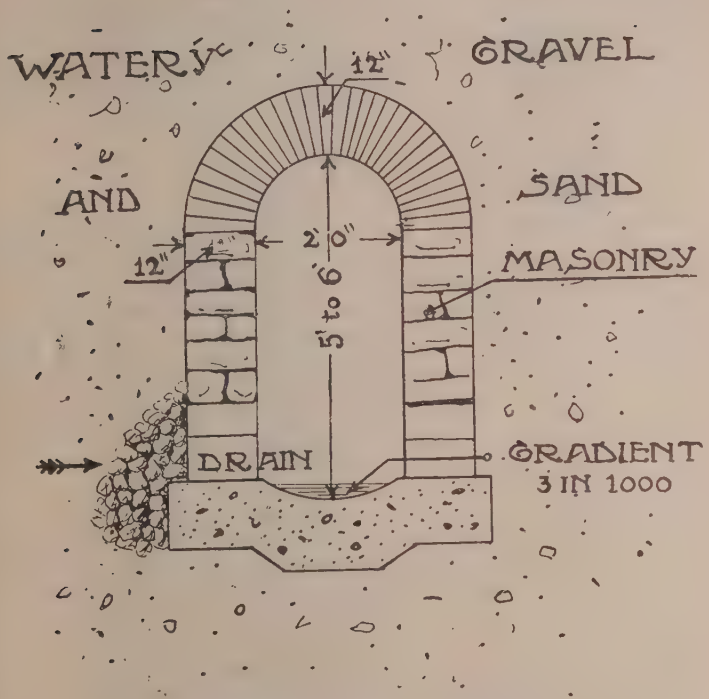
*When fairly cleared of silt, Mr. MARRETT reported the gallery as yielding 1,705,536 gals. per 24 hrs.; or 180 gals. per foot run of gallery. FANNING quotes 150 to 200 U.S. gallons per square foot of bottom area, as amounts that may be reasonably expected from suitably situated galleries.

Fig. 4.



INFILTRATION TUNNEL

Fig. 5.

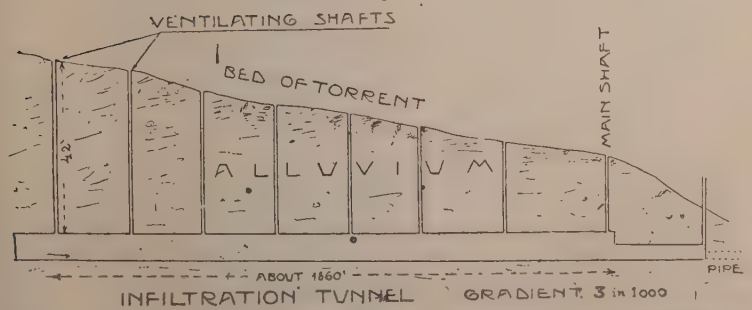


Fig 4. Infiltration Tunnel at Mazzara, Sicily. Discharge, 23 Gallons per Second.

subsoil drain, relief well, or series of relief wells which, whilst lowering subsoil water as an anti-malaria measure on plains at the foot of hills, may also serve for the collection of drinking water for inhabited areas at lower points. Nor in attempting the double function indicated in the first part of this Note, need it be held necessary that methods depending upon gravitation for points of discharge be solely trusted to, in flat areas. The lowering of the subsoil water table in a malarious tract can also be secured by pumping for the water-supply of distant localities. [See also this *Bulletin* (Sanitation Number), Vol. 8, No.5, Oct. 15, 1916, pp. 313-325.]

Experimental Anti-Malarial Measures.

In a Note under malaria in the preceding pages, it has been shown that the Bengal Presidency is happily passing from prolonged debate as to what anti-malaria measures should be adopted to action. Certainly, an area in which the deaths from "fevers" during 1916 were nearly a quarter million less than in 1915, but still amounted to 909,880, is to be congratulated on the prospect. The Government of Bengal in its Resolution on the Reports of the Sanitary Commissioner, Sanitary Board, and Sanitary Engineer for Bengal, (Municipal Department), 1916-17, states that a beginning was made of three out of four schemes designed by Dr. Bentley (Sanitary Commissioner for the Government of Bengal) "as experiments on anti-malarial operations."

[The problem involved in all anti-malaria efforts is the timely prevention of moisture surplus to plant growth from forming collections of water suitable for the breeding of Anophelines in the proximity of dwellings, within the flight-distance of the malaria-bearing mosquito of the locality. The only answer to that problem must always be that in no one place can one engineering method, or anti-malarial palliative measure, be adopted to the exclusion of others if success is courted. Hence it may be concluded that the Sanitary Commissioner considers the localities suggested by him as the object of experiments are suitable for the more extensive employment of a particular method than elsewhere. In so far, the efforts will be of value; but if conducted in the spirit and strictly within the limit of experiments on single methods, their sanitary and financial value must be minimized.]

The following is the description of these anti-malaria efforts as afforded in the Government Resolution* :—

"Two of the experiments are to be made in the deltaic tracts, viz., one in a rural area in the Burdwan district and the other in the town of Jangipur in the Murshidabad district. The Sanitary Commissioner describes these schemes as follows :—

'In the Burdwan and Jangipur schemes the idea is to take in the silt-laden waters of the Damodar and Bhagirathi rivers, respectively, during the floods so as to reduce what is called areas of mosquito-breeding edges by converting a large number of small pools into a big sheet of water, and at the same time to enrich the soil by allowing the silt to deposit on agricultural land. By constructing a series of regulators and sluices, it is arranged to control the flood water, so as to allow only a sufficient

* Tenth Triennial Report on Vaccination in Bengal for the years 1914–15, 1915–16 and 1916–17. By Dr. C. A. Bentley [M.B., D.P.H., D.T.M. & H.]. Sanitary Commissioner for Bengal. 1917. Calcutta: The Bengal Secretariat Book Depot. [Price Indian, 9 annas; English, 10*d.*]. pp. 2–3

quantity that may benefit the crops and not drown them ; and at the same time only the silt and not the sand may be deposited on agricultural land—a special method technically known as 'Bonificazione.' By this method it is also contrived to flush out old insanitary tanks and ditches, and in course of time to silt them up.'

"The basis of the third experiment is a system of subsoil drainage, which has been successful in Panama and the Federated Malay States, but has not been attempted in Bengal in connection with the anti-malarial operations. This experiment is to be made at the Meenglass tea estate in the submontane region in the district of Jalpaiguri. A fourth will be carried out on a colliery situated at Singaram in the Burdwan district, in the rolling upland country which covers a large area in West Bengal. In these latter tracts the chief carriers of malaria are believed to be stream-breeding mosquitoes which differ in their habits from the common carriers of malaria met with in deltaic areas. The two schemes have been specially drawn up with the object of ascertaining the best method of dealing with these mosquitoes and determining the minimum area round a village that must be controlled in order to bring about a reduction of malaria.

"At Meenglass the hill streams, in which a dangerous species of anopheline mosquito breeds, will be put underground, the water being carried off in subsoil drains when the flow becomes sluggish, while the storm flow is allowed to pass over them in the usual stream channels. The Singaram scheme consists of two parts, viz., (1) a thorough surface drainage of the area to be experimented on, and (2) the periodical flushing of a small river in which malaria-carrying mosquitoes of a vicious character breed. The object of the first part is to drain away pools and depressions in which malaria-carrying mosquitoes breed ; that of the second is to substitute a series of flushes in the river instead of a sluggish flow, for it has been ascertained that mosquitoes breed along its edge when the flow is gentle, but when the river is in flood their eggs and larvae are carried away. It is therefore proposed to construct a weir with sluices so arranged that, when the sluices are closed a head of water will be accumulated behind the weir, and this will be periodically discharged so as to flush the bed of the rivulet. It is hoped that three of the schemes will be completed during the current year ; and the Governor in Council looks forward to the results of the experiments with much interest."

Reinforced Concrete Roofs.

"Concrete" (London) according to the *Indian and Eastern Engineer* of Jan. 1918, p. 9, contains an article by Mr. A. B. Price, A.M.I.C.E., wherein, as a result of prolonged experience in India, he has no hesitation in advising the use of reinforced concrete roofs in that country. He insists that, provided ordinary care is forthcoming, success must result. He urges that the proportions of the cement (slow setting to be preferred), sand, and stone mixture cannot be secured by following a "rule-of-thumb" formula. He prefers to "define the proportions as 4 to 1, 3 to 1, and so on, leaving the exact proportion of stone and sand to be settled by practical trial." Similarly, by experiment the largest size of stone permissible may be ascertained : "for, in some cases crushed stone of 2 in. or even more may be used, provided the rest of the smaller crushed stuff goes along with this, only eliminating the actual dust for strength, and retaining the usually small quantity of dust in case of a watertight mass being required." For the rest, he warns against making the mixture too sloppy ; " and then, as an *essential* matter, requires the concrete to be kept moist when *in situ* to prevent it drying before true "setting" has taken place. For this purpose, water must be sprinkled or squirted on to the surface of the concrete, and also the centering

underneath continuously for several hours immediately after laying, gradually lessening attention till about a week old: then only an occasional watering will suffice during the next fortnight at least—the longer the better."

In regard to the steel employed, Mr. PRICE advises it "should in every case be placed ready for inspection by a responsible Officer before concreting is commenced."

The article finishes with the following statement:—"Contraction of concrete is greater in hot, as compared with temperate climates, and therefore such large areas of flooring or roofing cannot be taken. Joints in sections must be allowed for, to prevent unseemly, ragged, and detrimentally effective cracks developing later in the work."

[The above are construction details which normally fall within the function of the engineer, and should be left to him; but it is of advantage for the sanitarian to know that, if care be taken in execution, there is no reason why because a hot climate is concerned his preference, on sanitary grounds, for reinforced concrete in certain structures should not be met. Mr. PRICE'S paper in emphasizing the necessity for careful watering of cement work during setting (which, in practice, must rest with subordinate engineering staffs) points to an item liable to be perfunctorily performed, which, *ceteris paribus*, is a frequent cause of failure.]

ECONOMY IN STRUCTURE.

The Chief Engineer, D.P.W., Madras Presidency, in reference to a type plan for market buildings has issued the following memorandum (Procs. San. Board Madras No. $\frac{658}{8}$, 2nd Nov. 1917):—

"It is observed that, in many of the designs submitted for couple roofs, the collars are placed far too high up. This is objectionable especially in cases in which the collars are let into the rafters.

"For general guidance the following rules on the subject should be adopted:—

"(1) For spans up to 10 feet (clear), a single collar is considered sufficient and it should be fixed to the rafters just above the level of wall plates.

"(2) For spans from 12 to 14 feet (clear), two collars should be provided, one just above the level of the wall plates and the other about half way up the rafters.

"(3) In all couple roofs, the collars should be simply spiked or bolted to the rafters and the rafters should on no account be cut or notched to receive the collars."

OVERCROWDING AND TRAMWAYS.

In the Madras City Corporation Report for 1916-17 the President (dealing with a population of over 500,000, large numbers of the labouring class of which are in overcrowded dwellings) gives the following definite opinion as to relief of congestion to be obtained by the use of tramways:—

"As in the Report of 1915–16, I reiterate my belief in the absolute necessity, from the sanitarian's point of view, of tramway extension, and my hope for a speedy sanction by Government of the programme submitted by the Tramway Company. 'Relief of overcrowding' is an idle phrase, unless extension of cheap and rapid communications there be to lend reality to it."

Meteorology and Town Planning.

In the Review by the Government of the Punjab of Municipal Administration during 1916-17 a record of an extraordinary rainfall, as a factor in town planning, is afforded :—

"In July 1916 *nine inches of rain in five hours* [italics not in original] destroyed a large part of the town of Muktsar; rebuilding has been carried out in accordance with a regular scheme that will greatly improve the town, and proposals have been made with a view to saving it from floods in future."

VITAL STATISTICS.

East Africa.

In the abstract of official statistics on p. 381, concerning East Africa, if the lamentable toll of life on active service in the country's cause be excluded, there is evidence that life for the European year by year is being subjected to less risk, *pari passu* with improved sanitary circumstances. This is specially marked in the case of East Africa and Uganda.

Results in Zanzibar and Somaliland are obviously inferior. In both of these, however, it must be remembered that the total population of officials dealt with is very small, and that a coincidence of casualties may at times produce exaggerated ratios.

Deaths.

Year.	East Africa. Rate per 1,000.	Uganda. Rate per 1,000.	Nyasaland. Rate per 1,000.	Zanzibar. Rate per 1,000.	Somaliland. Rate per 1,000.
1910	14·5	14·2	22·6		—
1911	13·6	13·4	—	Not	43·5
1912	9·1	7·9	—	known	85·2
1913	10·2	—	6·7		38·5
1914 (a) ..	7·6	21·2	18·7	38·5	30·3
(b) ..	5·4	10·6			
1915	6·2	10·5	6·3	Nil	57·1
1916 (a) ..	12·1	7·4	29·8	17·9	—
(b) ..	7·6	—	22·4	—	28·6
Invalidings.					
1910	14·5	42·6	—		150
1911	6·8	13·4	22·7	Not	87
1912	4·6	19·8	21·9	known	Nil
1913	9·0	7·2	20·1		38·5
1914 (a) ..	9·8		18·7	19·2	Nil
(b) ..	8·7	24·7	12·5		
1915 (a) ..	13·4		50·3	18·5	85·7
(b) ..	11·3	13·9	44·2		
1916	10·9	18·4	29·8	Nil	57·1

(a) Includes active service casualties.
(b) Excludes active service casualties.

The following remarks in the official publication aid the interpretation of the Tables :—

"The rate for Somaliland still remains high owing to the retirement on pension, for reasons of ill-health, of two officials, each with nearly twelve years' service in the trying climate of that Protectorate.

"From the particulars given below it will be seen that about fifty per cent. of the invalidings are due to nervous and mental troubles."*

*[See this *Bulletin* (Sanitation No.) Vol. 4, No. 4, August 15, 1914, p. 216. It is probable that irrespective of the predisposing influence of a tropical climate, solitary life incidental to certain forms of official duty in which congenial European companionship is rare, is accompanied by undesirable introspection. Life "in small stations" is, on this account specially liable to excite minor phases of "nervous and mental trouble."]

Return giving Particulars of Officials who left the Service during 1916.

Protectorate.	Average No. in Service.	Deaths Rate per 1000.	Invalidings (including Officers Pensioned owing to Ill-health).		Total No. who left the Service.	Average age on Termination.	Average Length of Service on Termination.
			Rate per 1000.	Average length of Service.			
				yrs. m.			yrs. m.
East Africa Prot. (a) ..	916	12·0	10·9	9 8	76	35	4 4
East Africa Prot. (b) ..	—	7·6					
Uganda	272	7·3	18·4	9 3	16	34	5 9
Nyasaland (a) ..	134	29·8	29·8	2 10	12	31	3 11
Nyasaland (b) ..	—	22·4					
Zanzibar (a) ..	56	17·9	—	—	6	33	3 0
Somaliland	35	28·6	57·1	11 5	10	37	3 4
Totals (a) ..	1413	13·4	14·9	7 4	119	34	4 2
Totals (b) ..	—	9·2					

(a) Includes active service casualties.

(b) Excludes active service casualties.

"These statistics now include only the ordinary civil establishments of the Protectorates, and not officers of the King's African Rifles. . . . Particulars of Zanzibar officials are not available prior to 1914.

"10·9 per cent. and 17·6 per cent. respectively of the total number who left the service were due to deaths and invalidings. The remainder were due to retirements on pension on grounds of age, completion of agreements, resignations, etc.

"In reckoning the length of service of officials the time spent on voyages to and from East Africa and leave in Europe has been included. The actual period spent in East Africa may be put roughly at four-fifths of the total service. . . .

"Officers pensioned had at least ten years' service in East Africa, except in cases of transfer from pensionable appointments elsewhere."

Anguilla.

The Medical Report of the Presidency of St. Christophers and Nevis for 1916 (Senior Medical Officer, W. H. Fretz) shows that the little population of Anguilla (4,671) had no reason to envy the health conditions of its neighbours, if vital statistics be maintained with equal accuracy. The results reported [p. 1] are as follows:—

Locality.	Birth-rate.	Death-rate.
St. Kitts	30·3	26·9
Nevis	32·4	17·1
Anguilla	34·6	11·9

Dr. Burton, the Medical Officer of Anguilla, gives the following account of sanitary conditions [pp. 3-4]:—

"The health of the island during 1916 has been excellent. No epidemic of any kind occurred during the year. The sanitary conditions in and around the dwellings continue excellent, and this in spite of the scarcity of water. Even for washing purposes it is at a premium in this island at certain seasons. The total number of deaths for the year was 66, of which 54 were medically certified. No successful vaccinations were performed this year owing to failure of lymph."

Whilst the islanders may be sympathized with as to the absence of means of personal cleanliness, it is possible they may have the consolation of absence of inimical effects of imperfectly removed waste water. But, as the figures stand, in contrast with those of its neighbours, they are sufficiently encouraging to give rise to the hope that "after the war" to the excellent condition "in and around dwellings" may be added a sanitarily sound water-supply, and a further reduction of mortality.

Fiji.

According to the Annual Report of the Medical Department, Fiji, for 1916 (Chief Medical Officer Dr. G. W. A. Lynch) in a population of 163,565, in Fiji, 4,705 are Europeans, 59,565 Indians, and 90,429 Fijians—the rest being, in fairly equal proportions, half castes, Polynesians and Rotumans, with a few of the ubiquitous Chinese and "others." The birth-rate for Europeans was 16. The rates for three preceding years were 21·85, 22·11 and 27·89. The rates in 1916 were 34·50 and 36·09 for Fijians and Indians, respectively. For these races also, there is a tendency to decrease of rates compared to

previous years. The Chief Medical Officer apparently sees no reason to ascribe these results to pathological influences; he holds that "the same causes which influence the falling birth-rate in so many countries influence them also in Fiji."

Tetanus in Venezuela.

In an estimated population of 2,824,934, Venezuela (*Public Health Reports* 1917) had in 12 years a total of 683,932 deaths from all causes, of which 7·5 per cent. were due to tetanus, whilst of the total tetanus cases 40 per cent. were in infants.

Book Review.

Standard Methods for the Examination of Water and Sewage.—xvi + 115 pp. Third Edition. 1917. Boston, 126, Massachusetts Avenue: American Public Health Association.

In Applied Hygiene, it has become increasingly evident as the mass of knowledge rendered available by the Bacteriologist and Chemist has accumulated, that technique, as advised by various authorities, differs to an extent liable to trammel advance. Thus language used to describe results, when the technique by which they were arrived at has been dissected in controversy, at times, has been found literally to imply "the same thing only different." Consequently, it has long been held as likely to prove of advantage were defined methods generally followed in conducting bacteriological or chemical investigation, so that conclusions arrived at would permit ready comparison. For instance, in every day practice in respect to water, loose methods of citing *B. coli* without differentiation as implying faecal contamination and, in the chemical analysis, reference at one time to constituents as parts per million or per 100,000, at another as grains per gallon imperial or U.S., do not conduce to rapid cerebration in deciding hygienic value. But if in contesting the results of an examination (say, by an interested water company) it were possible to prove that the manner of collecting and transport of specimens did not take cognizance of bacteriological or chemical purity, or that technique of examination omitted to exclude certain factors, doubt may well be thrown on the whole procedure. Whilst therefore it would be a mistake to trammel exploitation of new methods, it is evident that general adoption of standard laboratory methods must result in economy of time and in clearness of conception of hygienic values.

The task of arriving at standards by the process of exclusion of diverse opinions of various authorities, is one that might well appal an individual worker. In any case, an *ipse dixit* standard would receive little attention, even from the hands of the best recognised authorities.

It has been reserved for the Americans not only to see the necessity for laying down standards, but to perceive these must be dictated impersonally by recognised corporate Bodies. The third edition of "Standard Methods for the Examination of Water and Sewage" is the outcome of consultations by the American Public Health Association, American Chemical Society and the referees of the Association of Official Agricultural Chemists. This book embodies a remarkably concise and lucid set of rulings as to both chemical and bacteriological procedure.

It would certainly aid sanitary advance if, either formally or informally these rulings were adopted on this side of the Atlantic. It would be a great matter, in the presence of common sentiment and a common language, that in the readily available literature of both nations, advantage should be taken of accepted standards in describing results of investigations. Indeed, if already it has been feasible to establish an "Office International d'Hygiene Publique" (in the creation of which Germany did not participate) which still publishes its monthly Bulletin, it should not require much effort to secure, on the basis of the American effort, an International version of "Standard Methods." The advent of peace may bring with it this possibility; but, in the meantime, the wide use of the book in medical schools and laboratories would render this consummation practicable.

Throughout this work, there is strict adherence to the principle that methods of procedure and not sanitary interpretations of results are under consideration. The Committee however make one exception, which is certainly well warranted in reference to the varied findings of recent years; a warning is thus conveyed:—"The Committee feels that a word of caution should be given regarding the significance of the presence in a water of members of the *B. coli* group as defined in this report. Recent work seems to indicate that the *B. coli* group as herein defined consists of organisms of both faecal and non-faecal origin. Therefore, care must be exercised in judging the sanitary quality of a water solely from the

determination of the presence of members of the group." This caution would seem specially applicable to work in the tropics, where the *B. coli* is peculiarly elusive in surface water, and where its absence, notwithstanding recent contamination, would be dangerously misleading. Indeed, as shown by CLEMESHA (to whom science is indebted for this* and other allied facts as to behaviour of water borne microbes under natural conditions in the tropics) eighteen hours exposure to sunlight conditions may suffice to secure complete removal of *B. coli*, necessitating greater reliance being placed on the more resisting representatives of faecal pollution.

In the nature of things it cannot be expected that any set of standard rulings can be applicable for all time; changes must be expected at even shorter intervals than have afflicted the British Pharmacopoeia. Indeed, if in the laboratory pet methods (alias "tips") are to be put aside for standard methods it is but "human" that preference for other procedures be expressed. Already the "standard methods" have been attacked by Passed Assistant Surgeon H. E. HASSELTINE.† He contends that "if the New Standard Methods be adhered to in the bacteriological examinations of water, time lapse and material will be unnecessarily expended and untrustworthy results may be obtained."

On the particular ground selected (identification of typical *B. coli*) in this criticism, there would appear to be room for the discussion as to material and labour expended, but there would seem little for the suggestion that "misleading results" are obtainable; provided not a part but the whole procedure of the "standard methods" be followed. It is however an important feature of a work embracing "standard methods" that the procedures should not be the outcome of individual opinion, but the crystalized products of material that has withstood the solvent action of criticism. Hence healthy criticisms such as launched by Asst. Surg. HASSELTINE will not result in further diversified opinions, but in a consolidation of impartial findings when, in due course, the advance of Chemistry and Bacteriology necessitates a new edition.

W. G. K.

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* The Bacteriology of Surface Water in the Tropics, by Major W. W. CLEMESHA, I.M.S., Sanitary Commissioner with the Government of India. pp. 64–70.

† *Public Health Reports.* 1917. Nov. 9. Vol. 32. No. 45.

Correspondence.

Daniels & Newham. **Laboratory Studies in Tropical Medicine.**

Dear Sir,

Your Editorial Note on page 316 of the April issue seems to call for some explanation from us as publishers, especially in connection with Dr. Daniels' remark: "I think the practice of many editors of sending marked copies from the Editor is worthy of imitation, but this review I have seen *through the kindness of a friend.*"

Apparently owing to an oversight at the Bureau the copy containing the review only reached us on April 16th. The same day we communicated with one of the authors. One may assume therefore that Dr. Daniels' attention was called to the matter before that date, but this does not remove the implied neglect by the publishers which your note seems to convey.

In fairness to ourselves we ask that the same publicity may be given to this explanation as has been given to the Editor's note.

Yours faithfully,

[*Signed*] John Bale, Sons & Danielsson, Ltd.

Messrs. Bale, Sons & Danielsson are quite correct. The publisher's copy had not been sent when Dr. Daniels wrote and the omission was not detected till the note had been passed for press. In any case there was no intention to impute neglect to the publishers; the custom in this matter probably varies.—[Ed.].